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ORIGIN OF SEED.

The importance which is now attached in Europe to the source of seed used for artificial regeneration work, is probably not realised in this country, and a brief summary of an account of the subject published last year by Dr. Schwappach in the well known series of Neudammer educational forestry booklets, may accordingly be of interest. A first edition of this book appeared in 1914, but considerable progress has been made with the connected organisation since then, and it is mainly this aspect which will be new to most of us.

Over wide areas in the North German plains, from Holland to Russia, plantations are to be seen which have originated from imported seed and are characterised by extremely bad growth form and irregular stocking, the latter condition being due in the main to the ravages of needle-cast disease to which the imported races were far less resistant than the indigenous. So bad were some of these plantations that in one circle alone, some 3,000 acres have already been prematurely clear-felled and re-planted. It is estimated that the losses to German forestry ascribable to the use of unsuitable seed runs into millions of Marks, and the trouble is not over yet, as the defects not always obvious at first become more apparent as the plantations advance in age.

Prohibition of import of foreign seed, cones and plants into Germany was impracticable owing to commercial agreements.

Already in 1910 co-operative measures were initiated at Darmstadt among the seed extraction and forest nursery firms, foreign stock being boycotted, and supervision by the State Forest Department invited. In 1919, this supervising function was taken over by the German Forstverein, but the State Service continued to co-operate.

It became evident, however, that exclusion of foreign seed went but a small way towards solving the problem, as seed just as unsuitable for a given locality was available within the country itself, and a procedure to meet this difficulty was evolved, and initiated in 1924. It was decided that all imported seed and cones must be coloured with eosin to render possible immediate recognition, and a heavy customs duty was imposed (excluding species not freely available in Germany). A special organisation was introduced for classifying growth regions and for the certification of seed. A central committee of control was appointed consisting of 12 members, 3 each from the Forstverein, 3 from the Forest Department, 3 from the Agriculture Department and 3 from the business firms concerned; this committee is responsible for the supervision of the import of foreign seed, and for general organisation. Local committees were also appointed as required and carry out the work of approving proposed localities as suitable for the collection of seed which can be certified for use. Such seed must come from a division or part of a division having demonstrably an indigenous crop satisfactory as regards shape, volume production, soundness and resistance to disease. These local committees push the use of certified seed in every way and do all possible to make the total amount available adequate for all requirements, and that without any undue rise in price. It is thus hoped to oust from the market seed which has been collected at random wherever easiest and cheapest.

The number of separate growth regions recognised for Scots Pine—for which species alone matters have advanced so far—is surprising. The four main tracts are East Prussia, North German plains, the broad valleys of Hanover, and South-West Germany, and these are sub-divided into eleven circles all kept separate. It

will be apparent that trading in uncertified seed and similar practices are not 'verboten,' but it is hoped they will die out as the new procedure establishes itself.

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AGRICULTURE AND FORESTRY IN INDIA.

PART II.

(*Continued from pp. 634-39 December* 1928 *issue.*)

We now turn to the important matter of fuel and small timber for the villager and at the outset it will not be exaggeration to say that the provision of these valuable commodities to the villagers are an important and anxious consideration with the majority of forest officers.

We may quote again from the Report, pages 263-4 :—

> " The position in regard to fuel is in some respects very similar to that in regard to fodder. A limiting factor is the cost of transport by road or rail. The Chief Conservator of Forests in the United Provinces was specially emphatic on this point. He informed us that the supply of firewood in rural areas depends greatly on the cost of transport from the forests and that the forests of Gorakhpur division were an almost solitary exception to the general position, which is that quantities of unsalable fuel are left to rot in the forest. He added that special means of transport, such as tramways, are seldom profitable when firewood alone is concerned, and that the only remedy likely to be of much value was the reduction of the rates charged for carriage of fuel by rail, which appear excessive and seriously curtail export. These rates adversely affect the export of charcoal and bamboos as well as of fuel. His evidence and that given by the Conservator of Forests, Bengal, shows the urgent

need of a thorough examination of the whole economics of the supply of fuel to the cultivator. The practice of burning cowdung cakes is partly, no doubt, the result of preference. It is a slow-burning fuel and a fire once started can be left to take care of itself. But, apart from preference, cowdung is at present the only certain supply of fuel which the great majority of cultivators can obtain. As we have pointed out in Chapter IV, before any intensive campaign of propaganda in favour of the substitution of another form of fuel can be justified, not only must a supply of that fuel be available but data proving that it is cheaper for the cultivator to use the substitute offered him than to burn his manure must have been obtained. Such data will require to be based on an investigation in each tract of the loss, in terms of the local crop production, involved in burning cowdung, and of the calorific value of the woods or charcoal available in the locality as compared with that of coal, when price is taken into consideration. We would draw attention to the investigation recently carried out by the Agricultural Chemist in the Punjab and his Research Assistant on the loss in terms of crop production by burning cowdung as illustrating the kind of investigation we have in mind. In this connection we consider that the railways should review their charges for the conveyance of wood, charcoal and coal, and should pitch their rates as low as possible, so as to secure the large potential traffic resulting from the importation into the rural districts, in bulk, of any or all of these fuels. In deciding the relative cheapness of the different classes of fuels, it will be necessary to experiment with suitable cheap stoves in order to ascertain their efficiency value for each class of fuel. In any area in which it has been proved that wood is an economical fuel, steps should be taken by the Forest Departments, where this has not already been

> done, to establish fuel depôts for groups of villages. The co-operation of the railway authorities should be sought in the establishment of fuel depôts at stations."

It is not difficult to criticise these remarks. Cheap stoves are unlikely to be a marked feature of the ordinary village household for many a year to come. What we want to do is to give the villager cheap wood which he can burn in any way he fancies (without thinking of its calorific value) and to teach him at the same time that cowdung is the finest manure for his fields that he can obtain.

What is very disappointing to forest officers is the fact that the Commission have not definitely advocated the formation of plantations in the neighbourhood of agricultural lands. All they say is:—

> "If the investigation which we recommend is to be carried out with the thoroughness which its importance demands, it is essential that it should include an enquiry into the economic possibilities of establishing plantations for fuel and the creation or extension, for the same purpose, of plantations along canal banks and the margins of rivers and streams."

There are many districts in India where there are no forests at all and it would undoubtedly be beneficial to introduce them. It would obviously take many years to carry out enquiries into economic possibilities of plantations, and these years we consider will be time lost.

The Inspector-General of Forests in his evidence given at Simla definitely recommended the formation of plantations :—

> "*Have you any definite schemes in your mind?*—No. It should be done in every district where it is found possible to undertake some scheme of this nature. I would suggest that every district should be critically examined with a view to seeing what areas we can take up on which we can plant forests which will pay and be of general good to the district as compared with keeping the land under agriculture. It is not

a matter where one can produce a scheme even for a Province. You would have to do it for the districts."

The Chief Conservator of Forests, Punjab, was strongly in favour of plantations, mostly, of course, in the Punjab, on irrigated land :—

" *Are you attempting to form enough to provide one acre per head of the population there?*—We have not worked it out to that particular figure. We are attempting to supply the entire requirements of the Punjab, but we have nothing like so large an area as we require for that purpose, 3,000 square miles have been disforested in the past 25 years, and well over 1,000 square miles more are going to be given up for colonies. Those 4,000 square miles are all situated in the plains. Those forests are the ones which used to supply practically all the firewood requirements of the Province: the towns, the military (which is a very large demand) and, to a smaller extent, the agricultural demand. Those have now gone, or are in process of going. We do not see where the supply of fuel is coming from when those have gone, because, of our plantations, there is only one in full bearing now. Five more are in formation, but even when they are in full bearing, they will not be in a position to supply the whole of the demand.

Are your plantations "plantations" in the strict sense? Are you planting trees?—They are entirely artificial. The trees are sown and planted. They are created out of absolutely bare land.

Are there any areas enclosed with the object of getting natural regeneration?—Not in the plains.

That is impossible?—Regeneration is mainly natural in the plains, but it is coppice.

What are the trees you usually use?—Shisham and mulberry in the plains."

In his evidence the Chief Conservator of Forests, Madras, was rather inclined to belittle the part that the Forest Department

could take in helping the agriculturists in his province. We think this attitude is greatly to be regretted and that he was losing sight of one of the great objects of forestry in India.

In Bihar and Orissa the forest witness was more reasonable and stated :—

"*Mr. Gibson takes the view that if the forests which, from the forest point of view, are useless, were given more skilful attention, far more might be made of them from the agriculturists' point of view. Do you agree with that statement?*—I agree with that entirely; it is a question of fencing.

They should be enclosed.—That is my personal view."

* * * * *

"*Having regard to the large areas concerned, the population and their traditional rights in the forests, is it not almost certain that if any steps are to be effective, the villagers must be taken with you willingly?*—If possible yes. The villagers are allowed a large number of rights in some forests, but the amount of rights is very seldom specified in the notification in which those rights are allowed, and the difficulty is to prevent their selling, to a third party, timber which they are entitled to only for their own use."

* * * * *

"*Do you know any case of zamindars having planted areas with forest for fuel or timber.*—I do not. But within the last year, certain zamindars in Chota Nagpur, have raised the proposition that their forests should either be taken over by Government or managed by Government on their behalf, but they are always apt to want very accurate estimates of costs and to expect forests, previously much abused, to yield an immediate, handsome financial return, without further investment of capital in communications.

Is there any attempt by villagers to grow quick growing fuel trees for their own use?—No, I have never heard of any. I have heard of a few villagers in Chhota Nagpur who

tried to control the cutting of fuel trees in their village forests, because there was so much local scarcity of fuel, but they have never deliberately planted it themselves."

The Conservator of Forests, Bengal, was in favour of plantations:—

"*I understand what you say in answer to question 19, but do you think there is any opening for planting with trees reasonably good land not at present cultivated?*—Yes, I should say that all high land which is not paddy land will grow trees and that as the demand for dry crops is very small you could practically work the whole of the high land in Bengal under *taungya* on short rotation and produce much more forest than you have now and get as much dry crops as you get now. They are doing shifting cultivation now without getting any trees up.

Do you think Government could control that in any way?—I think the only possible way to do it is that Government (in the widest sense) should control it. I do not think the Forest Department could take over the whole work straight off and run it. You cannot take over large tracts of country where no one has ever seen a forest before and start close forest conservancy; you will simply cause a riot. You have to approach the matter a little more carefully than that, and as we are not experts in the careful handling of situations, it is not our job. I think there are certainly places where we could take it on, but those are in the more out of the way districts; where there is a certain amount of forest left there is also a certain amount of forest ownership worth holding on to, as in the south-west corner of Bankura, for instance. There we could take over the forest by paying the man who owns it now and run it as a forest. But where it is a question of planting a little bit of high land alongside a village it is more than we could

tackle; it would take a certain amount of finesse and probably a certain amount of brute force as well, before that could be done.

Do you think if you had a special section chosen for tact as well as for drive they could take it on?—Such a special section would not necessarily consist of foresters; because all they would have to know would be a little plantation work. It might contain 10 per cent. of foresters, 40 per cent. of civilians and 50 per cent. of policemen.

Have you ever worked out the economie side of any proposal of that sort?—Yes. In Bankura, I worked out as far as it can be worked out. One can see it would be profitable, but it would be difficult to give exact figures for what a forest is going to be worth if it is looked after when one has only seen the bare shreds of it left.

Do you think if the matter was examined and experiments made it might prove to be remunerative?—Certainly.

Do you think this large area of forest is capable economically of supplying the cultivating population with more fuel than it does at present?—With much more than they take now. We are working up the business of sending it by rail, and we are sending more and more fuel down, by rail now. The difficuly is that in Bengal there is one lot of forest at one end and one at the other, with nothing in between. We can do nothing for the cultivator who lives in between unless he is on a railway line. Along the railways we are gradually working up a market for firewood. In most places we have much more firewood than we can sell, and we are trying to work up a market for it and gradually extending its sale. The idea is that a shopkeeper in the bazar buys a truckload of firewood from us and retails it. In that way we can help places near a railway. People away from the railway can only get firewood by having forests of their own."

(*To be continued.*)

THE RATE OF INTEREST IN FORESTRY.

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United Provinces.

PART I.

1. The future development of the forests in India will largely depend upon the amount of the available capital which the country can invest in forest schemes. Forestry, like any other business concern, could not possibly hope to attract capital unless its economic soundness is established beyond doubt. The expenditure incurred in the formation of new forest plantations or in the development and perpetuation of existing forests could not be justified unless it could be shown that the money so spent has been profitably employed. The measure of financial soundness of an investment of capital in any business concern is furnished by the rate of interest which it would ultimately yield. The determination of the rate of interest which forest investments would yield is, therefore, of vital importance to the future of forestry in India. That the forest rate per cent. should compare favourably with the bank rate and the dividends distributed by various companies is a *sine qua non* for the attraction of capital in forest projects. The flow of capital is largely governed by the well known factors of security and the rate of interest and to a lesser extent on the ratio of supply and demand of money. To establish the economic soundness of forestry, it is, therefore, essential not only to ascertain the rate of interest it would yield but also to examine the nature of security which forest investments offer. The financier should be convinced that his money would be secure and would yield a rate of interest as good as in any other business, if he is to be encouraged to invest in forestry.

2. The determination of the rate of interest in forestry is, however, a very hazardous affair. The rate of interest which a forest property would yield in a given period is dependent on the cost of land, the cost of formation and management, and the amount of money realized from the sale of timber and other minor produce during that period. These factors vary not only in space but also in time. The element of time, which is un-

usually large in forest undertakings, renders all forecasts of income and recurring expenditure highly problematic. Future movements in the prices of timber, which constitutes the major produce in forestry, are governed by a variety of factors, the influence of which is as important to reckon with as it is difficult to ascertain.

3. The ratio of supply and demand for a given species of timber constitutes the main factor which determines its price. The demand for a given timber, in a backward country like India, varies with the rate of development of the country in general, the prosperity of its people in particular, and the discovery of new methods of its utilization. Scientific inventions influence timber prices in rather an uncertain manner. While it is true that science plays an important rôle in furnishing substitutes for timber and thereby diminishing its uses, the general tendency of an advancing civilization appears to be towards an increase in the consumption of timber. It may be generally stated that the inventions of substitutes for timber fall far short of discoveries of its new uses, and on the whole science may be supposed to stimulate rather than decrease the demand for timber.

4. Again, accidents like the Great War may inflate the demand for timber beyond all expectations. And, although such wars are mere unforseen contingencies, it may be added that they recur with an intriguing regularity. Whatever may be the odds against it, the probablity of the 'next war' influences the Continental, notably French, forest policy to a very large extent.

5. The problem of forecasting the future prices of timber is further complicated by the fluctuating value of the coin of the realm itself. The standard, which constitutes the measure of the value of timber, is in itself subject to variations over long periods involved in the production of timber. The purchasing power of the tokens of money fluctuates considerably from time to time, and depends chiefly on gold movements actuated by the general state of prosperity of a country and the currency policy of its Government. Normally, the currency of a country depreciates in proportion to the increase in its population and advance in its civilization. The depreciation proceeds imperceptibly unless accentuated

by accidents like the Great War or arrested by an acceleration in the production of the necessaries of life in a country, or lack of employment of its people. Thus, the British pound (1) suffered violent fluctuations in sympathy with the Continental currencies during the Franco-German War of 1870. Ever since, its value continuously appreciated till 1896; that is the price of ordinary necessaries of life continuously fell. From 1896, till the break of the Great War (1914) the prices in general rose and the value of the pound fell. This tendency of slow but steady depreciation of money, which continued till 1914 under normal conditions, was considerably exaggerated during the Great War and the period immediately following it. The English pound touched bottom in 1920 when a ten shilling note went about masquerading as a pound note. During the last 8 years the purchasing power of the English money has again been rising. The pound is slowly recovering from the effects of the War and the 1928 pound has recovered now to six-eighths of the 1914 pound. The Indian rupee moves in sympathy with the English pound in a sluggish but sure manner. The two currencies are inter-related and respond to each other in sympathy. It may be generally stated that, *ceteris paribus*, the value of money normally depreciates as civilization progresses. The depreciation is slow but steady. The rate of depreciation varies with the state of civilization and resources of a country. In an undeveloped country like India, the depreciation goes on at a slightly higher rate than in European countries. During the last 50 years the Indian rupee has depreciated to about a fourth of its value. The depreciation is greater since the Indian rupee, unlike the English pound, is unable to recover from the effects of a war or similar accidents owing to the low economic vitality of the country. The rate of depreciation of the Indian rupee has been about $2\frac{3}{4}$ per cent. per annum during the last 50 years. Thus, although the capitalist, who invested a sum of Rs. 10,000 in bank at 4 per cent. compound interest, 50 years ago, will have to his credit Rs. 71,000 to-day, the actual purchasing power of his accumulated capital has depreciated during this period to about Rs. 17,000 only. Obviously, therefore, he lived in a fool's

paradise. While he believed all the time that his investment yielded him 4 per cent. compound interest, he actually got less than $1\frac{1}{4}$ per cent.

6. Having examined the limitations which the element of time imposes upon the factors which influence the forest rate of interest, we may now proceed to modify the fundamental data from which it is derived so as to involve errors, if any, on the safe side. We have seen that for a given rotation the rate of interest in forestry is based on :—

(*a*) The cost of land.

(*b*) The cost of formation and management.

(*c*) The revenue from timber and other minor produce.

7. Of these factors, the cost of land may be taken as the market value of the land without any significant error. It may be observed that an allowance should be made for the rise in the value of land in course of the rotation of a forest crop in view of the general appreciation of property which takes place as civilization advances Assuming, however, that the value of land will rise in proportion to the rise in prices of other necessaries of life, the net appreciation of the value of land in relation to the index figure will be negligible. Or, in other words it may be supposed that the value of land will appreciate in the same proportion as the currency will depreciate. The appreciation of the value of land in virtue of its amelioration by the enriching properties of a forest crop may well be set apart as a margin of safety against unforeseen accidents. The market value of land is, therefore, a true and safe indicator of the cost of soil. The cost of land, if may be noted here, should be based on the price of fairly extensive areas and not of isolated pieces of land which may bring fancy prices. Those who advocate the exclusion of this factor from interest calculations altogether, on the plea that the Government of this country acquired forest land by conquest and as such paid little by way of compensation make the colossal blunder of not identifying the interest of the nation with that of the Government. Such fallacious arguments, which undermine the very foundations of the national economy, need not detain us.

8. The cost of formation will be reckoned in the current coin of the realm. The annual recurring expenditure (e) is best provided by considering that capital (E) which would regularly yield in simple interest the annual expenses. The capitalized expenditure simplifies the calculations considerably. The objection, that the rate of interest at which the capitalized amount is expected to meet the annual expenses, is subject to variations over long periods is easily met when it is remembered that the amount involved is so small that fluctuations in the rate of interest will not cause any material difference.

9. The evaluation of the future yield from a forest may best be carried out on the basis of current prices. Timber prices in India, corrected against the index figure, indicated hardly any appreciable rise up to 1913. That is, the price of timber varied in sympathy with other commodities during the period preceding the Great War. During the War, the index figure was subjected to erratic fluctuations and timber being comparatively less important than other necessaries of life did not respond at first proportionally to the rise in their prices. The price of timber was actually lower than the index figure during the War, but its aftermath witnessed a great increase in the demand for timber for new works which were kept in abeyance owing to the pressure of the War. Timber prices actually overshot the index figure during 1920-25, only to sink again owing to a sudden slump in the market. The market conditions have not yet settled down to their natural equilibrium. The following table illustrates the movement of timber prices with respect to the index figure. **(2)**

Table I.

Period.	1904-13.	1915-20.	*920-25.	1925-27.
Mean Index Figure ...	100	147	166	155
Timber Prices ..	100	127	173	136

*** Based on the period 1910-15.**

Assuming the future movements in timber prices equal to the rise in prices of other necessaries of life, we may regard the present market price of timber as a fair measure of its intrinsic value. The price of timber will undoubtedly vary from time to time but its value in relation to the index figure may be regarded as fairly constant over long periods. Thus, although a cubic foot of sal may fetch a much higher price after a hundred years than what it does to-day, the value of the coins of money will depreciate in about the same proportion. It is only to be hoped that errors, if any, involved in this supposition will be on the safe side, in view of the fact that the demand for timber will far exceed the supply with advancing civilization, increasing population and consequent encroachment on forest areas, and progressive depletion of the more accessible forests. We have also seen above that the influence of scientific discoveries and consequent development of a country tends generally to increase the demand for timber and as such its value. The present market prices of timber may, therefore, be regarded as an extremely safe and good standard with which to judge its real value for all time. The high probability of an increase in the demand for timber and consequent rise in its value provides a reasonable margin of safety against mishaps.

10. Provision should also be made in all forest plantations against partial failures, unforeseen calamities like frost, insect attack and other sources of injuries. It will be readily agreed that calculations based on a 70 per cent. efficiency basis will constitute sufficient safeguard against all normal failures. The final yield figure taken from a yield table should therefore be reduced by 30 per cent. By far the best method of allowing for this safety factor is to exclude all intermediate yields from consideration. The proceeds from thinnings and all other incidental forest produce with interest thereon would more than cover all possible normal losses in a forest area. This allowance is by no means excessive, since earlier thinnings which are likely to mount up at compound interest during the rotation are hardly worth anything.

11. The elaborate text book formula for the caluclation of forest rate of interest can now be modified as under:—

Let—

r be the rotation in years.
Sc „ the cost of land per acre.
C „ the cost of planting per acre and formation.
E „ the capitalized expenditure.
P „ the rate percent.
and Y „ the final yield.

Then, the total costs at the initiation of a forest plantation amounted at 'P' per cent. compound interest would be equal to the final yield, plus the cost of land and the capital provided for the current expenditure recoverable at the end of the rotation. We have thus—

$$(Sc + C + E)\ 1{\cdot}0P^r = Yr + Sc + E$$

$$\text{or, } 1{\cdot}0P = \sqrt[r]{\frac{Yr + Sc + E}{Sc + C + E}} \quad \ldots\ldots\ldots (1)$$

The formulae, usually given in the text books on forest valuation for the determination of the value 'P' are so cumbersome and complicated that their practical value is extremely limited. Thus, Schlich's formula (3) for the soil expectation value is undoubtedly awe inspiring and very imposing but it is incapable of being directly solved for the value of 'P.' Other authors, notably Continental, on forest valuation labour under the same disadvantage and content themselves by producing elaborate formulae of merely academic interest. The ingenious graphical solution of these formulae for the value of 'P' devised by Schlich (4) and Hiley (5) represent about the only attempts which have ever been made to popularize them. The graphical method for the determination of the value of 'P' involving, as it does, very laborious calculations, would not commend itself to the ordinary forester. The European device (3) of calculating the forest rate of interest by the relation, $\frac{Se}{Sc} \times p$, where p, the arbitary rate per cent. is multiplied by the ratio of the soil expectation value (Se) and soil cost value (Sc) does not give satisfactory results. As this value varies with 'P' the solution

is indeterminate. In face of these difficulties, the above mentioned formula, developed along the lines roughly indicated by Chapman (6), is specially to be recommended for its simplicity and the readiness with which the value of 'P' can be obtained from it. That this formula involves errors, is not denied, but the fact that they are made on the safe side renders it fairly above reproach.

12. As an example may be worked out the forest rate per cent. of the *khair* (*Acacia Catechu*) plantation at Lalkua (Haldwani Division, U. P.) started in 1927.—

Area = 100 acres.

r = 50 years *

Sc = Rs. 500, at Rs. 5 per acre †

C = Rs. 7,000, at Rs. 70 per acre including the hercules fence.

E = Rs. 6,000 yielding Rs. 240 a year at 4 per cent. for current annual expenses for weeding, supervision, etc.

Yr = Rs. 60,000 reckoning at the rate of 100 trees to an acre, at Rs. 6 per tree. ‡

We have, by substituting these quantities in the formula (1)

$$1\cdot0P = \sqrt[r]{\frac{Yr+Sc+E}{Sc+C+E}}$$

$$= \sqrt[50]{\frac{60,000+500+6,000}{500+7,000+6,000}} \text{ Rs.}$$

$$= 1\cdot0325, \text{ approximately.}$$

$$P = 3\tfrac{1}{4} \text{ per cent.}$$

The United Provinces Government have thus invested a total sum of Rs. 13,500 in this plantation which is guaranteed to yield

* The rotation would be nearer 40 rather than 50 years. The higher figure has been taken for safety.

† The market value of land is practically nil. Cultivators to till the land even free from all encumbrances are not available in this malaria ridden locality. As a matter of fact Rs. 5 an acre is rather excessive.

‡ The ruling prices of *khair* trees of late have been actually about Rs. 10 per tree. The lower figure has been taken as the rock bottom price to allow for all possible fluctuations in the *khair* market.

3¼ per cent. compound interest in value (and not in coin) at the end of 50 years. This rate, as we have seen above, has been corrected against the index figure. The financial soundness of this scheme could be only judged by instituting a comparison with the rate of interest which other schemes would yield for the same capital.

13. The bank rate, which fluctuates from year to year depending upon the general economic condition of a country and chiefly on the ratio of supply and demand for money in the market, does not afford a safe standard for purposes of comparison. The Imperial Bank of India does not guarantee a given rate of interest for more than one year and gives no quotation for compound interest. If for the sake of argument the current rate of interest 4 per cent. is assumed to function in an uninterrupted manner for the next 50 years, the State or the individual will then be faced with the alternative of depositing their money in a Bank at 4 per cent. or to invest it in the Lalkua plantation at 3¼ per cent. At first sight the former course seems to be more profitable than the latter. But it should be remembered that the forest rate is a value rate and in order to institute a just comparison the bank rate should be modified to allow for the depreciation of currency which will take place during the next 50 years. We have seen that the Indian rupee has depreciated during the last 50 years at 2¾ per cent. per annum and there is no reason why the depreciation of money should not be the same, if not greater, for the next 50 years. At a conservative estimate the currency depreciation rate may safely be put down at 1½ per cent. per annum. The bank rate should, therefore, be reduced at least by 1½ per cent. in order to allow for the depreciation in the value of money, if it is to be compared with the forest rate. The current bank rate would, therefore, amount to 2½ per cent. against which forest plantations can very well hold their own.

14. It would be instructive to examine the rate of interest which the landed property yields to its owners in India. In no case the *zamindari* ever yields more than 2 per cent. and yet everybody in India who happens to have some spare money would

rather invest it in lands than in any other concern, however, bright the prospects of its being profitable may be. The reason why land attracts capital at such a low rate of profit lies in the fact that landed property, apart from yielding profits at about 2 per cent. per annum appreciates in value at about another 1½ per cent. with reference to the index figure. There are, of course, other attractions like security, and the added dignity which is associated in this country with land owners.

15. The dividend or the rate of interest which the invested capital yields in industrial concerns is enveloped with an element of uncertainty which renders comparison with forest rate impossible. The commercial companies, unlike forest business, draw up their balance sheet on an annual basis and declare their profits from year to year. The fortunes of these companies are governed by a variety of factors over which, little, if any control, can be exercised. Their profits vary from year to year and if an average is struck of the profits of an individual concern over a long period, the average rate of interest it would yield would be quite low.

16. The State undertakings which involve investments of public money do not always yield a higher rate of interest than Banks. In British Isles the rate of interest which obtained for a considerable period on gilt-edged securities did not exceed 2½ per cent. The State loans are usually floated on a company basis and are, practically speaking, on the same footing as the capital invested in other industrial concerns. There is, however, this distinction that the state guarantees a fixed rate of interest for a longer period than commercial concerns. The forest per cent. should in all fairness be favourably comparable with the rate at which the State raises its loans with the modification that it should be averaged over as long periods as are involved in forestry and corrected to the value basis.

17. For the State to pay a higher rate of interest on the capital raised for investments in forestry than what forestry could ensure is too preposterous a proposition to discuss here. In the example cited above, if the Government of the United Provinces borrows a sum of Rs. 13,500 to invest it in the Lalkua plantation at a rate higher than 3¼ per cent. compound interest, which the

plantation is likely to yield, the proposition is highly uneconomic and it would pay the Government not to undertake the scheme at all. It must, however, be again emphasized that the forest rate of $3\frac{1}{4}$ per cent. is the value rate and if the Government can raise capital at $4\frac{1}{2}$* per cent. the investment of money in the Lalkua plantation would still be profitable, since the higher rate of $4\frac{1}{2}$ per cent. on the loan actually represents, in value, 3 per cent. approximately† after allowing for the depreciation of money at $1\frac{1}{2}$ per cent. per annum. In no case the forest per cent. should be lower than the rate of interest which the State pays on its loans. Otherwise it would be more profitable for the Government to utilize its surplus capital in reducing the national indebtedness rather than investing it in forestry. Expenditure in forestry can only be justified if the returns are assured at a rate of interest higher than what obtains with the State loans.

18. The method of repayment of the loan, raised by the Government for this purpose, is extraneous to the issue, since the rate of interest varies as the method of repayment.

(*To be continued*).

EVERGREEN FORESTS IN BRITISH MALABAR.

(To compete for the Brandis Prize).

1. There is evidence to show that evergreen forests extended right down to the sea coast, before man came with his deadly "Malabar axe" in one hand and fire in the other. These virgin forests have gradually been pushed back as the population increased and are now found only in inaccessible regions above 2,000 ft. in elevation. On account of the peculiarities of the Malabar land tenancy, most of these forests are in the hands of a few "Jenmies" (Zamindars) and only a small portion, obtained either by escheat or by costly acquisition, remains under the

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* $4\frac{1}{2}$ per cent. represents the rate at which the Government of India have issued their latest loan, *vide* Government Gazette, The United Provinces, July 27th, 1928.

† Correctly speaking it will be $4\frac{1}{2}-1\frac{1}{2}-1\frac{1}{2}$ per cent. of $4\frac{1}{2}$ or 2·93 per cent. which may for all practical purposes be placed equal to 3 per cent.

control of Government. Rainfall is heavy, the average being over 150 inches per annum. The climate is equable, the temperature varying from about 75 to 85 degrees Farenheit. Humidity is very great and from June to December it is almost always near the point of saturation. In places far away from human habitation it is healthy.

2. The hill forests of the Himalayas or the high forests of the Gangetic plain are examples of good forests, but a typical evergreen forest is a class by itself and has no rival either in density of crop or variety species. It represents the ideal primeval tropical forest practically untouched by the destructive hand of man. Trees grow as densely as possible and all age classes are represented, and direct sunlight very seldom reaches the ground. The topmost canopy will be over 100 feet in height and the variety of species is bewildering. It is no exaggeration to say that about 500 species of trees and shrubs are found in the evergreen forests, affording a rich field for a systematic botanist.

3. *Hopea*, *Mesua ferrea*, *Calophyllum elatum* and *tomentosum*, *Dichopsis elliptica*, *Poeciloneuron indicum*, *Artocarpus integrifolia*, *Dysoxylum malabaricum*, *Cullenia excelsa*, *Acrocarpus fraxinifolius* and *Vateria indica* are a few of the economically important timber trees. Several species of *Eugenia*, *Myristica*, *Garcinia*, *Litsaea* and *Cinnmomum* are found. Of all these the most beautiful and majestic tree is the *poon* (*Calophyllum elatum* and *tomentosum*), a large tree up to 18 feet in girth with a clean straight bole reaching a height of 150 feet. It is an exception to find a crooked and deformed *poon*.

Mesua, *Poon*, *Dichopsis* and *Cullenia* are the commonest species. Gregariousness is an exception though certain species are found confined to particular localities. *Poeciloneuron indicum* and *Vateria indica* are good examples.

4. The forest floor is moist, rich in humus and splendidly protected, although these forests grow on steep hill sides with heavy rainfall. From June to January the ground is always wet.

5. The description of an evergreen forest is never complete without a word about the ubiquitous land leech and the trouble-

some nettle. When the ground is wet, as it usually is, millions of leeches are seen everywhere. *Laportea cranulata* is an innocent looking beautiful shrub, but is a dangerous nettle. It has poisonous hairs on its leaves and tender stems. If bare skin touches these, it will produce swelling and severe pain for a number of days, often accompanied by fever. It is known as the "devils nettle" and its local names translated into English means "mad nettle" or "elephant nettle." These two combined make life miserable and the inspection of these forests a very unpleasant affair.

6. Wild elephants abound in these forests and are found throughout the year. In their migrations from place to place they use the same regular tracks year after year. Sambhur and black bear are common and the Nilgiri Ibex is found on precipices and hill tops. The black monkey and the beautiful Malabar squirrel proclaim the advent of the visitor from tree tops. "The whistling school boy", the imperial pigeon, and large hornbill are the commonest birds found in these forests. The latter make a peculiar noise during flight, which is at first rather awe-inspiring.

7. Though the destruction of evergreen forests in the plains commenced with the advent of man, the process of cutting and burning for clearing land for agriculture, stopped, when, all available cultivable land was occupied, thus pushing back forest to the hills. As a result of this natural process of jungle clearing for extension of cultivation, we now find a belt of deciduous forest of varying width immediately above the fields and above this the untouched evergreen type. An exception to this will be found in places like Attapady Valley where some aborigines who escaped complete destruction at the hands of more powerful invaders, were also pushed back along with evergreen forest, and these jungle tribes are still engaged in shifting cultivation, with the result that here the area of evergreen forest is being rapidly reduced.

8. During the time of Indian Rulers, Malabar was governed under a kind of feudal system. The whole country was divided

into a number of small estates each under a chieftain, whose duties to the supreme ruler of the land were the maintenance of a number of soldiers for war service when required, and the annual supply of certain provisions such as rice, ghee etc. These chieftains were removable from service, at the will and pleasure of the ruler and a permanent right of ownership to the estates was never recognised. When the East India Company annexed Malabar from Tippu, as an emergency measure to bring the land under settlement, they conferred upon the chieftains, actually in possession of these estates, a permanent right of ownership. This unwise action has been the source of never ending trouble in Malabar and the various Moplah risings and tenancy troubles. All the hill areas and forests have become the property of the "Jenmies," who even claim ownership to river beds. This unrestricted private ownership of practically all the forest areas in Malabar presents a serious problem, though in early days the evergreen forest areas themselves were not threatened, on account of their inaccesibility.

9. With the exception of areas under paddy cultivation the whole of inhabited country of Malabar consists of gardens, growing valuable trees, like coconuts, teak, *aini* (*Artocarpus hirsuta*), jack, mango etc. These trees produce enough timber to meet local demands for house construction, agricultural implements, furniture, etc. Forest areas proper are not therefore exploited for local market. Forest areas near floatable streams were, however, worked for export purposes, and until the first railway was constructed the whole timber trade was by sea. The construction of railways facilitated timber traffic with the dry eastern districts of the Madras Presidency and this new timber market along with demand for fuel for the locomotives, resulted in the denudation of extensive areas of hill forests of the Western Ghats. Exploitation was mostly confined to the deciduous forests as these were nearer to the line of export, and contained well known valuable timber, like teak, rosewood etc. The evergreen forests on the other hand were far in the interior and only one or two species of timber trees in them were considered valuable at that time. These were *Hopea* and White cedar. This

was the state of affairs when the Great War broke out. It can be safely stated that up till this time the evergreen forests of the "Jenmies" were not worked to any appreciable extent.

10. The position of affairs in these private forests will be more comprehensible from the following brief description of the peculiar Malabar law of inheritence known as "Marumakkathayam" law, by which property is inherited through the female line. After the death of the head of an estate, the next man to succeed him, is his immediate younger brother; maternal cousin, or in the absence of brothers or maternal cousins, his eldest nephew. It usually happens that a man becomes the head of an estate when he is far advanced in age. He will thus have only a few years of life to enjoy the lucrative position. Though the benevolent East India Company conferred upon him a permanent right of his estate, fate has decreed otherwise. He can enjoy the estate only for a very short time and that too with very limited powers. He is not allowed to involve the estate in debt and his children cannot succeed him.

11. After the War there was a sudden boom in the timber trade in Malabar. Many commercial concerns were floated in Bombay and elsewhere to exploit the private forests of Malabar. The absence of restrictions on the ownership of private forest gave the heads of these estates power to lease their forests for twelve years, to cut and remove timber. The majority availed themselves of this opportunity and leased out all their forests to traders, not merely for 12 years but in many cases for 99 years, in order to realise as much money as they possibly could, in the quickest time.

12. From this time onwards commenced the real exploitation of evergreen forests owned by private individuals. *Mesua ferrea* was hitherto an unknown timber and was never exploited to any extent till after the War. As a result of declaring this timber suitable for railway sleepers all *Mesua* trees of any size disappeared from private evergreen forests in the course of a few years and other evergreen species are being felled and converted into cart shafts for the east coast market. As if to hasten the destruction of private forests a new railway line from Shoranur

to Nilambur has been built and was completed last year. This line runs along the foot of the Western Ghats making all forest areas more accessible and it does not require great powers of prophecy to say that these private forests will soon disappear. The best areas of evergreen forests have almost all disappeared and felled over areas are being burnt every year.

13. The effect of this wholesale destruction of the hill forests of Malabar is not apparently being realised. These forests are all climatic, protective, and situated in the catchment areas of important streams, and for this reason are essential for the well being of the nation, not primarily for yielding timber, but as a security against floods, drought and famine. During the floods of 1924 thousands of acres of valuable paddy fields were laid waste, several bridges and houses washed away, and hundreds of land slips occurred. Standing on the top of a hill, the writer was able to count, at one time, thirteen land slips (an ominous number). If this kind of destruction is permitted the number of floods and land slips will increase and the cultivated country below will become waste land.

14. To prevent this calamity, action on the part of the Government, if necessary to the extent of acquisition of private forests in special localities, is essential. The present position is that all these forests have been overworked and are in a most exhausted state. Private owners and their lessees know very well that for years, if not for generations to come, they will not be able to make much out of these forests. Such being the case it should not be a very difficult matter to purchase these areas cheaply. Such a purchase must not be considered as a business proposition, likely to result in immediate profit to the Government. It is highly improbable that any income will be derived from these areas for the next fifty years at least; further, Government will have to meet a recurring annual expenditure for their maintenance and protection.

Our obligation to the future generation makes some such intervention imperative and it is only in this way that it is possible to correct the mistake committed by the East India Company in handing over these areas to private individuals over a

century ago. It is worth mentioning that the States of Travancore and Cochin, similarly situated, did not commit the blunder of permanently handing over the hill forests to the "Jenmies." Hills and forests remained the undisputed property of the Sovereign with the result that they are now all under the control of the State Governments. Out of 7,000 square miles, the entire area of Travancore State, over 2,000 square miles, are State Reserved Forests and then there are hundreds of square miles of State Reserved lands. In Cochin State out of some 1,600 square miles, about 600 square miles are State forests. Compare these figures with those in British Malabar with an area of about 5,800 square miles and 500 square miles of reserved forests and practically no reserved lands. The forest area in possession of private individuals amounts to 2,000 square miles approximately.

15. Before the British Government created Reserved Forests in Malabar extensive areas in several localities were cleared early in the 19th century, for coffee and tea plantations. Most of these were abandoned some years later for various reasons. When the Forest Department was brought into being the majority of the available forest areas were made reserved forests and early in this century six blocks, to the extent of about 100 square miles, of private forests were acquired for protecting the source of the Bhavani river. At that time proposals for acquiring further areas of private forests were under consideration but unfortunately with no result.

Of the total area of 500 square miles of reserved forest in British Malabar only some 200 square miles are evergreen. These evergreen forests were strictly protected till 1919 when it was thought that mere protection of evergreen forests without exploitation was too conservative a policy and a start was made to work these areas.

16. The writer does not propose to deal with the Chenat Nair Exploitation Scheme which was inauguarted for the exploitation of these evergreen forests, except to the extent of giving a general idea of the method of working. It is not possible to classify the working under any of the scientifically accepted silvicultural systems. It may be called the American mass-pro-

duction method of logging. All sound trees are cut and removed by up-to-date machinery including tractors and sky line skidders. In this process of exploitation most of the unsound and young trees left unfelled, were damaged. This description will give a trained Forest Officer a general idea of the appearance of such a forest after exploitation. Up to date about 1,000 acres have been worked in this way.

17. As a rule Forest Officers in the past had very little to do with evergreen forests of this type and as a result the silviculture of evergreen forests has not been studied to any great extent. Out of several hundred species of trees and shrubs found in these forests very few are known to an average Forest Officer.

18. By studying the abandoned clearings made for tea and coffee plantations during the early part of last century, we should be able to learn something of silviculture of evergreen species. Most of these areas are now grassy hill slopes. In this grass we find a few shrubs such as *Maesa indica* and a hardy *Strobilanthes*, struggling against the grass, and in some places the *Strobilanthes* has practically killed out the latter. These were the areas actually under coffee or tea. As we pass outwards through the partially felled evergreen forests a low scrubby forest appears with thin grass underneath. Then there is a belt of better forest adjoining the completely untouched forests. Here we see old *Macaranga* and *Trema*, with an undergrowth of some saplings and seedlings of evergreen species. Occasionally we find some areas with a few old evergreen trees and under them a uniform growth of evergreen saplings. Such areas seem to have been partially felled but not burnt or planted. Here the evergreen saplings and young trees seem to be stunted and their height growth in proportion to their girth seems to be very poor. Thus we are enabled to see the various stages of the slow reappearance of the evergreen forests.

19. The conclusions we may be permitted to draw are, that if we cut and burn an evergreen forest and then abandon it, grass will take possession of the ground and nature will take an indefinite period, probably some hundreds of years, to reclothe the area with trees. After tree growth has established it will take

some more centuries to produce a forest equal to the original stand. Thus if our object is to preserve our evergreen forests, the worst thing one can do is to clearfell the forest and then burn it every year as the private forest owners have started to do.

20. In virgin evergreen forests we very often see small openings in the canopy caused by natural decay and falling of old trees. Such openings are comparatively small, say, 10 to 20 yards by 2 to 10 yards. Even here we do not find a crop of young evergreen seedlings. *Macaranga*, *Trema*, wild plantain, cardamom plants, devils nettle, and other apparently useless fast growing species take possession of the ground at once. In a few years' time the whole area is fully grown over, and underneath them, in the thick shade, seedlings of evergreen trees start growing. Gradually the fast growing species stop growing, reaching a maximum height of about 30 to 50 feet and the evergreen saplings push through and eventually suppress them. This is what we observe every day and everywhere in the evergreen forests. We may conclude that evergreen seedlings cannot put up with direct sunlight to any extent; they are not only shade bearers but shade demanders.

21. The experience gained in the logged over area of Chenat Nair Reserve mentioned in para. 16 above is very valuable. Felling was commenced in 1920 and several attempts were made in the heavily felled over area to plant up with *Hopea*, all of which failed. In practically unfelled semi-deciduous area some success was however obtained. The quantity of soil and humus which is washed down to the stream during the first monsoon after felling operation is considerable. The isolated, unsound and immature trees left unfelled, but mostly damaged, are being uprooted or broken down by wind. These trees, never used to such exposure and isolation, withstood the strong wind and storm till now, not by their own strength, but by the combined strength of the whole forest. As soon as the exploitation operations are complete the whole area becomes covered by a mass of "weed" growth, mostly *Macaranga*, *Trema*, and other fast growing species. Originally there was considerable growth of seedlings of evergreen species on the ground. Most of them were damaged

during the exploitation and the rest were overgrown by these fast growing "weeds".

Acrocarpus fraxinifolius is a valuable deciduous tree, but curiously enough, found only in the midst of high evergreen forest. It has peculiarities of its own to enable it to grow in such a fashion. Its seeds are enclosed in light pod, like the pod of *Albizzia procera*. These pods are carried far and wide by wind and do not open till the pods settle on the ground, It is a very fast growing tree, in fact as fast as *Macaranga* or *Trema*. If an opening is created in the midst of an evergreen forest by the fall of an old tree within one or two furlongs of a large *Acrocarpus* tree we invariably find a few *Acrocarpus* seedlings competing with *Macaranga*. By its fast growth it soon overtops them all, but being a light demanding light-foliaged tree, permits thick growth of evergreen trees underneath it. These trees when fully grown have enormous buttresses and so they are able to withstand strong wind in spite of their height growth. It is very fortunate that several *Acrocarpus* trees were left unfelled during the exploitation operations in the Chenat Nair Reserve. In the extensive openings created by logging, seedlings of *Acrocarpus* are growing profusely and in some areas at the rate of thousands per acre. In such areas there is every prospect of pure *Acrocarpus* forest. Will nature permit this? This species is never found in nature, growing in a pure crop, and signs are not wanting that nature will not permit any such artificiality. A kind of shoot borer has started attacking saplings and defoliators are seen eating all tender leaves as in the case of teak.

22. Apart from the Chenat Nair Exploitation Scheme, it is admitted by all experienced Forest Officers that these evergreen forests are in almost every case important as protective forests to be maintained for protecting the sources of the streams and high and steep hill sides, for the benefit of low lying cultivated lands, to prevent floods, drought, and consequent famine and pestilence. At the same time it is economically unsound simply to go on protecting these forests without extracting any timber, and exploitation combined with the maintenance of the protective powers of the forest should be the basis of management. For

this purpose one cannot do better than to imitate nature. This natural process of eliminating useless old trees is capable of being modified and exploitation should remove old trees, one by one, before they become unsound, all over the forest. This is the ideal selection method of working, one which has become unfashionable now-a-days, but which must remain as the only system for working our protective evergreen forests.

23. Out of hundreds of species found in evergreen forests only a few are valuable as timber at present and these only need be worked. At present we have considerable stock of overmature trees which should be the first to be exploited. It will not be possible to remove all these in one operation, as such fellings, where overmature trees are found in groups, will produce larger openings in the canopy than is desirable.

24. In the blanks created by felling these large trees, more valuable species, such as, *Acrocarpus fraxinifolius* could be introduced and in areas not under fellings more valuable species could be tended and specially favoured by cultural operations. In this way it will be possible to increase the value of our evergreen forests without endangering their primary function.

25. The above is the only wise course to be adopted in treating the evergreen forests of Western Ghats of Madras Presidency and it is on these lines that the latest policy of the Forest Department in Madras is being shaped.

"CALOPHYLLUM."

A NOTE ON MECHANICAL TRANSPORT AND SKIDDING OF FOREST PRODUCE IN THE SOUTHERN CIRCLE OF BOMBAY PRESIDENCY.

PART I.

The question of cheapening the cost of transport of forest produce from the forest to the purchaser or consumer has engaged the attention of Forest Officers of this Presidency for quite a long time but so far no satisfactory substitute for the inevitable bullock-cart has yet been found. In this Presidency two methods of

Mechanical Transport have been attempted at different times which have succeeded to a limited extent. They are mechanical transport by rail and mechanical transport by road.

TRANSPORT BY RAIL.

The Dandeli-Alnavar Forest Railway,

In Kanara high forests the chief source of revenue is by sale of timber. At present teak and about six to eight other species are being worked regularly. There are two outlets for this timber to reach the market; one, the line of depôts in touch with the M. and S. M. Railway (metre gauge) which are above the Western Ghats, and the other, the small fishing ports along the west coast of North Kanara District. The important railway stations nearest to the forests for the above-ghat markets are Hubli, Alnavar, Tavargatti and Nagargali, and the chief ports for the export of timber are Karwar, Hattikeri, Kumta and Honawar. The below-ghat timber is principally taken down by water transport to these ports. But all the above-ghat timber has to be transported by land to one of the above railway stations. So far the only method of transport was by bullock-carts on earth roads. During the Great War of 1914-1918 the demand for Indian timbers for war purposes increased greatly and in view of this demand and the difficulty experienced in securing enough carts Government sanctioned, primarily as a war measure, the construction of a metre gauge branch line from Alnavar to Dandeli, a distance of little over 19 miles. The latter place is situated on the banks of the Kali Nadi, in the heart of the above-ghat teak bearing area and is an important Forest Depôt.

The construction of this railway was entrusted by Government, with the sanction of the Railway Board, to the M. and S. M. Railway Company. The work was taken in hand in 1917-18 and completed in January 1920. The line was opened to goods freight traffic in 1921 and subsequently to passenger traffic in November 1924.

As was expected the revenue earning traffic on this Railway is one-way only, *i.e.* from Dandeli towards Alnavar with forest produce (timber, bamboos, and manganese ore). On account of

the fact that Kanara forests are but thinly populated there is paractically no revenue producing traffic from Alnavar towards Dandeli. The wagons have to run empty from Alnavar to Dandeli in order to bring freight from Dandeli to Alnavar.

The total capital cost of construction of this Railway up to 31st March 1928 is given below :—

		Rs.
1.	Preliminary expenses	8,699
2.	Formation (*i e.* the road way) ...	2,79,977
3.	Bridge-work	89,830
4.	Fencing	3,309
5.	Ballast and Permanent-way (*i.e.* the track).	4,09,613
6.	Stations and Buildings	30,969
7.	Plant	686
8.	Rolling stock	63,679
	Total Rs. ...	8,86.762

The total length of the line is (*a*) running line 19·12 miles
(*b*) sidings ... 1·96 miles

Total ... 21·08 miles

The Railway was completed after the War and due to the slump in the timber market immediately after 1921 the exports of timber decreased. The uneconomical running due to one-way traffic combined with this slump in the timber market made the running of this Railway a dead loss to the Department. But since 1926-27 there has been a slight improvement in this direction and the line has produced a small net earning over the running expenses during the last two years. The running of the line is handed over to the M. and S. M. Railway Company and a summary of the revenue and expenditure for the years 1926-27

and 1927-28 submitted by the Company to the Department is reproduced below :—

Expenditure.					Earnings.		
Gross amounts for the year ending 31st March 1927.	Per cent. on gross receipts.	Head.	Gross amounts for the year ending 31st March 1928.	Per cent. on gross receipt.	Gross receipts for the year ending 31st March 1927.	Head.	Gross receipts for the year ending 31st March 1928.
Rs			Rs.		Rs.		Rs.
5,130	7·32	To general administration.	3 799	7·13	4,574	By coaching earnings.	4,575
23,311	33·3	To ordinary repairs and maintenance.	22,912	43·0	64,811	By goods earnings.	48,207
11,327	16·2	To operating expenses.	8,179	15·3	635	By miscellaneous earnings.	495
1,376	1·96	To replacement and renewal.	4,562	8·56			
4,400	6·28	To share of joint station expenses.	4,400	8·26			
678	0·97	To interest on cost of rolling stock used.	6,027	11·3			
46,222	66·0	Total ..	49,879	93·6			
23,798	34 0	To balance net earning.	3,398	6·38			
70,020	100·0	Total ...	53,277	100·0	70,020	Total ...	53.277

From an inspection of these figures it is apparent that the running expenses of this line are practically constant from year to year. The net earnings therefore depend chiefly on the gross receipts under goods traffic, which are principally the transport

charges from Dandeli to Alnavar for the timber sold at Dandeli Depôt and exported by rail.

If therefore only the direct returns from this Railway are taken into account its financial position cannot be considered good, as in the best working year the profit represents less than 3 per cent. on the capital outlay. On the other hand the indirect returns really earned by this Railway are considerable. The increase in revenue from bamboos from areas which were practically unexploited before the railway was built is the most important, and amounts to not less Rs. 25,000 per annum. A second quite definite item of indirect revenue is due to the saving on carting of teak metre gauge sleepers from the Dandeli area, as the M. & S. M. Railway accepts delivery at Dandeli. At a very conservative estimate the savings under this item is Rs. 4,000 per annum.

Finally there is possibly some indirect return on the saving represented by the difference in rates between rail transport from Dandeli to Alnavar and cart transport from Dandeli to Tawargatti Railway Station (the then nearest railhead) on account of log timber sold in the Dandeli Depôt and sawn material cut in the Dandeli Mill. The railway charges average Rs. 4/12 per ton of 50 c.ft. What the present day carting charges for the 16 mile lead from Dandeli to Tawargatti would be, can not be definitely ascertained, but taking into account the rates paid for the only other long lead in Kanara from sale depôt to railhead, the charge is unlikely to be less than Rs. 8 per ton. If the most favourable estimate is taken there may thus be a saving of Rs. 3-4-0 per ton on an annual output of 2,000 tons of log timber and 1,500 tons of sawn material, or in round figures Rs. 11,000 per annum. On the other hand some authorities are of the opinion that if the wood were placed on the market at Tawargatti station on the direct M. & S. M. main line it would probably fetch a price larger than the Dandeli price plus freight charges from Dandeli to Alnavar. If this is correct the indirect return calculated above would be reduced or might disappear altogether.

The question of indirect returns may therefore be summarised by stating that they represent a definite return of 3 per

cent. on the capital expended, but this return may possibly be as high as $4\frac{1}{2}$ per cent.

TRANSPORT BY ROAD.

Sometime in 1911-12 mechanical transport by steam road wagons was attempted simultaneously in Northern and Southern Circles of this Presidency with two Fowler Road Locos. But after working for a short time it was noticed that the type of engine was too heavy and was not suited to the rough roads of the Forest Department. Most of the forest roads, then, had no bridges and even where there were any bridges they were not strong enough to take the load of tractors and trailers. The scheme was abandoned and the steam wagons were converted into stationery engines for working Saw Mills.

For nearly ten years following the above attempt no serious attempt was again made in this direction. In the year 1920-21 due to very high rates paid for carting timber from the forest depôts to the sales depôts and due to the great difficulty felt in securing enough carts to cope with transport problems it was found necessary to investigate again into the question of mechanical transport of timber. During these ten years the design of steam wagons for heavy load transport had made considerable progress and generally the condition of the Forest roads had greatly improved. The Forest Engineer of this Department was asked to go into the question in detail and submit practical proposals on the subject. The result of this enquiry was that a Foden steam wagon with one trailer was purchased in 1923. This outfit worked for one year on metalled roads and the results were encouraging so that in 1924 another steam wagon (Super-Sentinel Wagon) with a trailer was purchased.

The Foden outfit worked till May 1927. On account of the fall in the carting rates no Divisional Forest Officer was prepared to provide any work for the tractor during the working season of 1927-28, therefore since February 1928 it is used as an engine for a Portable Saw Mill in the Southern Circle. The Super-Sentinel Wagon worked till April 1928 when its activities were finally closed for similar reasons.

Below is a summary of the financial aspect of the operation of these tractors :—

Working season.	Type of load.	Length of round trip (return trip empty).	Type of road.	Cost per ton-mile excluding depreciation and interest (with load).	Cost per ton-mile including depreciation and interest (with load).	Cart hire per ton mile.
Foden	*Outfit.*					
1924-25 ...	M. G. Railway sleepers.	44 miles	Metalled	..	3·5 As. per sleeper.	3·5 As. per sleeper.
1925-26 ...	Do ...	64 ,, ...	Do ...	...	As. 10 per sleeper.	7½ As. per sleeper.
1926-27 ...	Logs ...	14 ,, ...	Unmetalled.	...	3 12 4	1 7 0
	Logs ...	24 ,, ...	Do ...	1 1 6	2 7 5	1 8 0
Super-Sentinel outfit.						
1925-26 ...	Logs ...	14 miles ..	Unmetalled.	...	1 11 0	1 7 0
1926-27 ...	Logs }	24 ,, ..	Do ...	...	1 6 0	1 8 0
		14 ,, ...	Do ...	...	1 14 0	1 7 0
1927-28 ...	Logs ...	14 ,, ...	Do ...	2 8 0	4 0 6	1 8 0

NOTE:—During 1924-25 this outfit worked for the department at the risk and expense of the supplying firm.

The following are the principal factors that have contributed to the failure of the steam road wagons in the second attempt to revive mechanical transport :—

1. The unsuitability of the design to Indian forest conditions.
2. Want of an efficient and prompt service of spare parts in India.
3. Deficient repairs service behind the operations.
4. Road conditions.
5. Local factors.

1. UNSUITABILITY OF THE DESIGN.

It appears that the tractors were designed for European conditions. The first trouble experienced with the Foden wagon was the breaking away of the solid rubber tyres after it had worked for one season on a first class metalled road. Probably the high range of variation of temperature in India was too much for the tyres. A complete set of tyres for this outfit costs as much as Rs. 1,600 and the work of fitting the same on to the tractor wheels can be undertaken only in a first class workshop equipped with a hydraulic press for forcing the tyre on the rim. In the case of the Super-Sentinel Wagon due to open transmission from the engine to the chassis by a series of chains and pinions there were frequent failures of chains resulting in delay and stoppages overnight on the road. Judging from the condition of these chains and gear pinions after a service of two seasons it appears that two to three seasons is about the maximum life for the whole set of chains and pinions under Indian conditions. A complete renewal of these would cost about Rs. 1,200 every other year. Due to the unsuitability of rubber-tyred wheels the Super-Sentinel Wagon was fitted with iron wheels. The heavy iron wheels on the other hand made steering extremely difficult on earth roads; and the Public Works Department prohibited the use of this tractor on metalled roads under their charge.

2. WANT OF A PROMPT SERVICE OF SPARE PARTS.

It appears that the Indian Agents for the above steam tractors are not in a position to stock all the spare parts as is done by the Agents of Motor Tractors, with the result that in the event of any unforeseen mechanical breakdown the spare parts in most cases had to be ordered out from the Works in England. This meant delay and generally prejudiced the case for mechanical transport.

3. ORGANIZATION, REPAIRS, OPERATION, ETC.

According to the Indian Boiler Act each steam wagon should be in charge of a certificated boiler attendant. An efficient 3rd class certificated hand could not be had on less than Rs. 100 per mensem. Such a man is not necessarily a good

driver on the road. It was found that in every case that a certificated man was appointed to run the tractor he was ignorant of even the elementary principle of steering and had to learn his job, naturally at the expense of the engine. An experienced man who could steer properly and understand the complicated and compact machinery of the tractors could not be had for less than Rs. 160 per mensem. It was not possible to engage such a man as the sanctioned rate for a driver and a mechanical engineer combined was Rs. 80 per month.

As stated above, due to the absence of efficient service of spare parts a lot of petty repairs work had to be done locally. The small workshop of the department was found to be incapable of carrying out the work and very frequently the Railway Workshops at Hubli and Government Workshops at Poona and private firms at Bombay and Calcutta were approached to carry out the necessary repairs. This increased the repairs charges and held up operations for days together.

4. ROAD CONDITION.

At first the Public Works Department refused permission for operations of these tractors on their roads. Finally after great persuasions the permission was granted on the following conditions :—

(*a*) The maximum axle load on tractors should not exceed 8 tons.

(*b*) The wheels should be rubber-tyred.

(*c*) The speed should not exceed 5 miles per hour.

(*d*) The damage to P. W. D. roads due to the running of the tractor should be borne by the Forest Department.

This ruled out the Super-Sentinel Wagon from operating on P. W. D. roads as this tractor was fitted with iron wheels. And as the rubber-tyred wheels had proved to be a source of great annoyance and expense on the Foden Tractor this practically ruled out the possibility of the running of tractors on P. W. D. roads.

Most of the forest roads are earth roads and in some few cases the gradient and the curves are not suitable for steam

wagon and trailer operations. The bridges on some roads were not designed to take heavy tractor loads. This meant that for successful running of these tractors parts of such roads had to be realigned and some bridges had to be entirely reconstructed. All these items of expenditure contributed to the detriment of mechanical transport.

5. LOCAL FACTORS.

In Kanara forests the working season is limited to about seven months in the year *i.e.*, from November to the end of May. For the rest of the year due to heavy rains and soft roads and unbridged nallas and rivers, transport operations of almost any kind are impossible. Even during the limited dry weather any local shower of even under an inch of rain stops all transport operations for about a week or so, as the earth roads become very soft and take a long time to dry due to the heavy forest cover on such roads. This limiting of the working season increased the overhead charges on account of interest and depreciation (calculated for the whole year) very considerably. As there is no local labour available in Kanara, great difficulty was experienced in inducing outside labour (specially trained men like drivers, firemen and others) to stay in the unhealthy localities where the tractors were operating.

The mechanical transport operations have again failed in this Presidency but the failure is not due to any inherent defect in the system of mechanical transport. All the defects and difficulties are surmountable with patience and organization.

The following conditions may be considered as *sine quâ non* for successful operations of this kind :—

1. The engine and chassis design should suit or be adapted to local conditions.
2. An efficient service of spare parts should be maintained either by the purchaser of the outfit or by the Local Agents.
3. The operations should be backed with a good workshop service for carrying out emergent repairs.
4. Efficient organization and technical staff should be available.

5. That sufficient work for the outfit should be available for the whole working season.

Conditions 1 and 2 are easily secured with a little foresight and by arrangement with the manufacturers.

As regards conditions 3 and 4 it would be expensive to maintain a good workshop and highly trained staff for one or two tractors only. If all the forest operations were simultaneously mechanized and a central workshop erected in a suitable place the incidence of repairs charges and technical supervision charges per unit would be much less. On the other hand it should not be forgotten that India is yet an agricultural country and mechanization has as yet touched only a fringe of its urban areas.

A bullock-cart is designed, manufactured and repaired by a village carpenter and smith. The bullocks do agricultural work when not required for carting. Hence the burden of repairs charges and overhead charges on account of depreciation and interest is not so heavy as in the case of the projects depending on costly mechanical plant. Therefore in order to beat the bullock cart the organization behind the tractors has to be a very efficient one so as to have a reasonable chance of success. Any haphazard attempt, although it might succeed in a specific case on account of any local factors adverse to the bullock-cart stands small chance of permanent success unless and until it is backed by the services and technical help mentioned above.—(*To be continued*).

T. K. MIRCHANDANI,

Forest Engineer, Southern Division,

Bombay Presidency.

NATURAL REGENERATION OF *ADINA CORDIFOLIA*.

1. The Chief Conservator of Forests, Madras, in his Inspection Note, dated 3rd November 1924 of the Mount Stuart Forests wrote as follows :—

"A phenomenon of much interest to the forester is the opious crop of *Adina cordifolia* mixed with *Stephegyne parviflora*,

which has sprung up naturally in the south-west corner of the 1922 teak plantation. Seedlings of these species—more especially the former—are growing most vigorously under the shade of the teak, which here has a complete canopy. The two species require too much light to permit of their becoming an underwood, but if similar crops can be produced in future, they will perform the very useful function of helping to form a mixed crop. I directed the District Forest Officer to make an experimental clearing of the growth in the neighbourhood of a big *Adina cordifolia* tree near the Mount Stuart hydraulic ram, to burn the debris and to see if a young crop of *Adina* can be obtained in this way."

2. An experiment was made in accordance with the above instructions in 1925, but failed for want of attention. Another plot of approximately 1 acre was selected below Mount Stuart rest house in January 1926 in mixed deciduous forest. The clearing was carried out in February and the burning in March 1926. All unburnt materials were removed from the plot. Two *Adina* and one teak mother trees were left standing; the *Adina* fruits fell during April and May, but the teak seeds had fallen before the burn. A thorough weeding was carried out early in June 1926 at the break of the monsoon and the area was kept weeded. At the end of July the Range Officer reported that there was no germination, and that the experiment was a failure. I inspected the plot about August 10th and found a dense mass of *Adina* seedlings from 1"—2" high over nearly 50 per cent. of the area, and a very fair quantity elsewhere. The Range Officer's pessimistic report had been due to the difficulty in identifying *Adina* seedlings in their very early stages.

In addition to *Adina* I found numerous seedlings of teak and *vengai* (*Pterocarpus Marsupium*), and a few of rosewood and *Terminalia tomentosa.* Further weeding was done as required and the plot survived the ensuing hot weather with the greatest ease. In June 1927 the average height of the *Adina* was about 1' 6", and there was a small patch of *Stephegyne parviflora* an inch or two higher. The teak seedlings were much bigger and ranged up to 6' in height.

6

In August 1927 the *Adina* averaged 3′ 6″ and by October their height was not less than 5′ 6′. Teak seedlings in December were 6′—10′ high and entirely free from epicormic branches or double leaders, whether isolated or surrounded by *Adina*. At the time of writing the *Adina* is about 9′ high and much of the teak is well over 12′ high. There are also numerous seedlings of rosewood, *vengai*, and *Terminalia*, and the plot is as fine an area of mixed deciduous regeneration as one could wish for. Congestion has made the *Adina* very spindy and the crop needs judicious thinning out.

I have purposely given no details of expenditure; as in such small areas figures are always unreliable. Either more money is spent on tending than would be economically possible on a large scale, or else work is done by subordinates and not debited to the experiment.

The cost should have been much the same as that of establishing a teak plantation, less cost of collection and dibbling of seeds, but no weeding was required in the 2nd year. The numerous teak seedlings are as good as, if not better than, the very best patch in the 250 acre plantation made at the same time as this experiment was started.

It is only fair to mention that three other plots have given very moderate results. There has been no complete failure, and the outstanding success of the plot described at least shows what can be achieved.

J. M. SWEET, I.F.S.,

27th September, 1928. *District Forest Officer, South Coimbatore.*

EXTRACT.

DEHRA FOREST INSTITUTE.

INQUIRY TO BE INSTITUTED.

It is understood that Sir Chunilal Mehta, of Bombay, will preside over a committee to be shortly appointed by the Education Department of the Government of India to enquire into the organisation, working and control of the Dehra Dun Forest Research Institute.

The sanction of the Standing Finance Committee of the Assembly was obtained for the expenses required for this enquiry which, it is hoped, will be instituted early.

The object of the enquiry is to ensure co-ordination with a view to the achievement of scientific accuracy and better interchange of knowledge between the investigation in progress at the Institute and similar investigation abroad, especially in America and Europe. The Committee will also examine the system of recruiting members of the staff, specially technical experts, and the system of training Indians for scientific research.

The Committee will consist of two members, one with scientific knowledge from England and the other a business man in India. No selection has been finally made of these two members but the announcement may be made shortly.

A NEW LARVICIDE FOR MOSQUITOES.

Robert Matheson and G. H. Hinman writing in an American *Journal* of Hygiene detail their experiments with chemically pure borax with crystalline and calcined sodium borate, and with commercial borax. The latter was found to be efficient as any. After experimenting with various concentrations the authors conclude that ordinary borax in the concentration of 1·5 grm. per liter of water proved an efficient larvicide for mosquito larvae. This retains its action for long periods of time in wooden pails. Borax did not stop egg-laying and hatching but in no case did the young larvae live for more than two days. They quote reports that borax pools do not produce mosquitoes, and that in a borax country, this substance is not absorbed into the ground but crystalises on evaporation of the water and is ready for the next rain. The authors suggest that there is a field of usefulness for borax as a larvicide.—(*Capital, 18th October 1928*).

FAUNA OF THE EMPIRE.

Sir,—May we venture to call your attention to the Society for the Preservation of the Fauna of the Empire? Modern firearms, facilities for travel, and the spread of civilization tend naturally to restrict the numbers of wild animals. The objects

of this society are to collect information on, and to stimulate interest in, their preservation in the British Empire, and, by co-operation with similar societies, in other countries. The society is very anxious to increase its membership, and we should feel very grateful for your assistance in bringing its work before the notice of those interested in the preservation of the fauna of the Empire.

We are, Sir, your obedient servants.

ONSLOW (President).
ABERCORN (Vice-President).
ALLENBY (Vice-President).
BEDFORD (Vice-President).
M. BEDFORD (Vice-President).
BUXTON (Vice-President).
CREWE (Vice-President).
GREY OF FALLODON (Vice-President).
LOVAT (Vice-President).
P. CHELMERS MITCHELL (Vice-President).

Society for the Preservation of the Fauna of the Empire, c/o Zoological Society of London, Regents Park, N. W. 8. (*The Times*).

LIFE OF WOOD-PULP PAPER.

It has generally been understood that wood-pulp was an efficient material for the manufacture of paper and that its introduction some fifty odd years ago for use in that way conferred a benefit inasmuch as it enabled paper to be produced at much less cost. But a lecture delivered by Mr. Norman Parley on "The Durability of Printed Papers and Manuscripts" at the annual conference of Special Libraries and Information Bureaux at Oxford took a gloomy view of the position. In the course of the lecture Mr. Parley said that when he was in the British Section of the Press Exhibltion at Cologne and saw the exhibits of first issue of "The Times" and other old journals, he found them in good order. They may have yellowed with age, but ink and paper had stood the test of time, and the journals were quite legible. In the seventies of the last century mechanical pulp paper came into general use and it is paper of quite another kind

"sheeted sawdust, and perishes in a few days, or even hours, on exposure to light and heat." This pessimistic statement sounds as an exaggeration of the facts, but Mr. Parley apparently knows what he is talking about. He says that important volumes in the National archives show paper the colour of strong coffee, the type standing on the page on a diminishing island of white. Some, papers of 1884 and onwards are so brittle that they cannot be bound. That sounds very serious, it is almost unthinkable that State and other documents, which it is essential to preserve, should be permitted to perish in a comparatively short time because the paper used is of a very perishable nature. The position was stated to be of such gravity that a committee of the League of Nations drew the attention of all Governments to it. The committee recommended the use of chemically pure rag-paper, the water-marking of all papers with the maker's name and standardised grade-marks; and an extension of the practice of printing preservation copies of newspapers on all-rag paper. The ribald may of course see a bright side to the situation, they may say that when a Simla secretariat building was burnt down some years ago nothing particular happened and things went on as usual in spite of the destruction of a vast mass of records. It is therefore conceivable that there is an advantage in perishable paper in order to relieve the congestion and to avoid the ever-increasing need of record space in Government offices. The crumbling paper, so much dust, could be put into the dust-bin, as a welcome riddance and there would be an end of it. It is, however, difficult to look at it quite as lightheartedly as this, papers, we all know, have a way of accumulating in an alarming degree and if it were not for the trouble of eternally sorting them a very large proportion of them could advantageously be relegated to the waste-paper basket from time to time, but priceless old books would be a world's loss if they crumbled to decay, and similarly there are many documents which are far too important for their disappearance to be regarded with equanimity. What then is to be done? The good old rag paper is durable, the wood pulp article is short-lived, are we to have two sorts of paper according to the circumstances? It would of course be possible to use the

all-rag paper for matters of great concern and the pulp-paper when lasting qualities are of no consequence, but even so it may sometimes happen that script that appears to be of very transient signficance at the moment may afterwards turn out to be of significant concern. Or will our scientific chemists be able to devise a means of improving the quality of modern paper so that it will endure ? Wood-pulp is now so universally in use that the previous problem was that the world's supply of soft wood would be exhausted in a few decades of years, and then it would be necessary to use some other material for paper making, bamboos and certain descriptions of grasses. But Mr. Parley introduces another factor in the case, he says that the British Museum and five other libraries under the Copyright Act receive all books and papers issued in Great Britain, last year there was a new book for every hour in the year, over 8,000 and he asks how many of them will be readable in even fifty years of time? He seems to think that in half a century, or possibly much less, they will have withered to such an extent that they will be mere rubbish. He appeals to librarians, authors, publishers, press and the public to support the movement for securing permanent records of the age we live in. If it is as bad as that, the prospects are disconcerting.—(*Indian Engineering*, *3rd November* 1928.)

[It is necessary to discriminate between chemically prepared wood-pulp and *ground* woodpulp, The latter is simply *wood* and contains all the elements of decay found in raw wood. The former, if carefully prepared, may be a perfectly pure cellulose with very considerable lasting properties. Ground wood pulp should never be used, even in small proportions in any paper to be used for permanent record. Ed.]

EMPIRE FORESTRY.

OPENING OF CONFERENCE IN CANBERRA.

Lord Stonehaven, the Governor-General, to-day officially opened the Empire Forestry Conference, which is meeting here under the chairmanship of Lord Clinton, Chairman of the Forestry Commission in Great Britain.

Mr. Bruce, the Prime Minister, in inviting Lord Stonehaven to perform the ceremony, said that the people of Australia had been very recreant in their duty to the forests. Australians were obsessed by the necessity of opening the land to agriculture and other purposes, and almost regarded forests as excrescences, and had done everything in their power to destroy them. Only during the last 50 years had Australia realized the possibilities of its great asset and reformed somewhat. Every year £4,000,000 worth of soft wood was imported. The Conference could advise Australia how to stimulate the production of indigenous soft woods to meet its requirements, and also how to assist by the extension of hard woods to meet the Empire's requirements. The Conference would make a great contribution to the welfare of the Empire.

Lord Stonehaven said that the Australians being true Britons it was natural that they should have a sturdy contempt for forestry. There were many signs that Australia's neglect of trees was passing. He had seen recently in the mallee country in Victoria and North Australia men who were saving trees.

Lord Clinton said that possibly there had never before been assembled a body of men more representative of the Empire. They had had a panoramic view of the forests of every State and had not been slow to recognize the inroads that agriculture had made on the forests. Originally forestry had been a small Cinderella, scarcely admitted into the family of agriculture, but it had been found that each was helpful to the other. The two sciences should produce a system of land settlement good for the worker. A very heavy task lay before the States in ensuring that Australia's forests should meet present and future demands and provide for an increasing population and the great development of industry which must ensue.

The delegates proceeded to the Australian Forestry School for the business sittings, which will last till next week.—(*The Times*).

MODERN FORESTRY.

Professor Dr. Ing Franz Heske, of Germany, an expert in Forestry, was asked by the Government of the Maharaja of Tehri

Garhwal to submit a scheme on the working and organisation of the State forests on modern scientific lines.

He accordingly came here last January and, after studying the situation and examining the Darbar forests for a period of nine months, submitted his report to the Darbar and left Dehra Dun yesterday for Bombay en route to Germany.

The report he has submitted to the Darbar is not yet available, but it is believed to be sound. It is understood on reliable authority that some of his suggestions are on the following lines:—

He recommends that the forests be controlled by experienced and trained Imperial Forest Service Officers, that all Divisional Forest Officers must be trained in the I. F. S.; that all Range Officers must be trained at Dehra Dun, and all Foresters trained at Ramnagar; that their pay and grade must be encouraging, and that the number of divisions and ranges should be raised from 3 to 5 and from 15 to 21, respectively. He is of opinion that, if the forests of the State could be efficiently managed, the income would be increased to several lakhs.

Two more State students, Pandit Paripurnanand and Pandit Kamleshwar Dutt, have left for Germany with Dr. Heske to receive training in Forestry.—(*Pioneer*).

THE WORLD'S TIMBER RESOURCES.

Alarming reports appear from time to time in the press and from the public platform concerning "the world's vanishing forests" and the "coming timber famine." These reports emanate principally from professors of forestry, students in arboricultural schools and colleges, and others so zealous and enthusiastic regarding the world's timber supplies for present and future generations, that they are inclined to be too anxious and overstate their case.

There are many good reasons why the forests of the world should be conserved and planting done as much as possible in

these times of timber prodigality, but the writer is strongly inclined to the opinion that the extreme reports referred to cannot be justified by proof.

The most important section of forest produce is that of pines and spruces (softwoods) used for general building purposes and ordinary wood utility work, and practical men in this branch of the trade discredit any idea of a timber famine. The writer has "sounded" prominent agents and importers, all of whom are of opinion that supplies from the north of Europe are always forthcoming, and as soon as one source fails there are plenty of others to take its place.

The principal European shipping countries supplying European consumers are Finland, Sweden and Russia. From official sources the writer knows that, from recent surveys, Finland's growth of timber is larger than present consumption, and the same is said, also officially, of the forests of Sweden that the increment is larger than the crop. The increases are not large and so do not allow for any great growth of population in the future, either at home or abroad, but both the above mentioned countries are conducting their forests on a highly scientific scale that, at present rate of consumption, should tend to make them larger than the reverse. Russia, even after dismemberment, has the largest timber area in the world—it is reported by the U. S. S. R. that it possesses 1,333·3 million acres of forests, compared with Finland's 63·8 million acres, and Sweden's 49·0 million acres, and yet the first mentioned country is not yet doing nearly as extensive an export trade as the others. Poland and other middle-European forest areas are not cutting more than would cover annual growth.

Europe seems to have enough wood to satisfy present demand for generations to come, but points of great significance are whether there is sufficient for the inevitably larger populations of the future, and whether the New World will not call upon the Old for building timbers, and that very shortly.

The United States softwoods are admittedly disappearing, and that country is already a large buyer of Canadian pine and spruce. Canada has 774 million acres of forest land, compared with Russia's 1,330 millions. It has been stated that the peak of

production of softwoods in the eastern provinces of Canada has been passed—that is an open question—but of British Columbia Mr. P. Z. Caverhill of the Forest Service of that Province, states that under capable and conservative exploitation, even with a considerably larger cut than the present, the forests would be perpetual. But we have to account for the fact that with the tremendous growth of the United States and the future of Canada in course of time the American continent, Australasia and the Far East will want all the American and Canadian soft timbers, as well as more European woods. That is a great point in favour of the—shall we call them ?—ultra-enthusiasts, and shows that all is not well with the forests of the world. They are sufficient for the present-sized populations, but will they stand the strain of the larger ones of the future ?

In giving figures of forest areas, it does not follow that these are all of merchantable timber, or what will in time become so, but even allowing for these, Europe and Northern Asia are well supplied, all things considered. The hardwood (furniture wood) situation is more acute than that of softwoods. We know that the hardwood of the greatest producing nation of the world—the United States—is being cut out. This is recognised in United States Government circles, and American money is being spent in finding new hardwoods elsewhere to support, as the home, supplies steadily fail, the ever-increasing factories and population. To combat this shortage the British Empire has enormous unexploited or partly exploited forests for the world to call upon, whilst Central and South America together possess illimitable supplies of hardwoods when the demand arises to stimulate exploitation.

Science and inventive genius (and especially when timber does get short of supply) will assist in saving the world's forests from exhaustion by finding suitable substitutes for wood for the making of paper. Indeed many of these have already been found, but are not yet sufficiently advanced to compete largely with young spruce wood. When that is accomplished, millions of acres of coniferous forests will be automatically saved year by year. Moreover as timber rises in value the many compositions

on the market will also greatly increase. Much more plywood will be used in place of both soft and hard woods, which will mean a great saving of wood and of trees.

There does not, therefore, appear to be any possibility of a world's famine, but it is well for all timber producing countries to be alive to possible timber shortage dangers, even within the early future. It is the duty of the Governments of the world to plant largely; to eliminate as much as possible, forest fires (the greatest consumer of the world's forestry wealth) and insect pests. This is being done fairly well to-day, but there is still considerable room for improvement. We should all, therefore, welcome world's forestry congresses, and although at times the speeches therein tend to frighten us, the international meetings of arboricultural scientists are of considerable benefit, by warning us of possible dangers not only to us, but to those who will follow.—(*World Copyright Reserved by London General Press*)—(*Reprinted from the Capital*, 18*th October* 1928).

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THIRD BRITISH EMPIRE FORESTRY CONFERENCE

(AUSTRALIA AND NEW ZEALAND) 1928.

Summary Report and Resolutions.

[We have much pleasure in publishing in our pages the report of the proceedings of the Third British Empire Forestry Conference, Australia and New Zealand, 1928. Ed.]

1. The Third British Empire Forestry Conference, consisting of the Delegates from the Empire whose names are given in Appendix 1, assembled at Perth, Western Australia, on 21st August.

Immediately on assembling, the following messages was transmitted to His Majesty the King :—

"The third British Empire Forestry Conference assembled at Perth, Western Australia, desire to offer to your Majesty an assurance of their loyal devotion to your person and to your Throne. It is their resolve that this Conference shall, as far as possible, be instrumental, as preceding Conferences have been, in promoting the better management and utilization of the forests of your Majesty's Empire."

The following gracious message was received in reply :—

"The message of the Empire Forestry Conference has been laid before His Majesty the King, who desires that an expression of his thanks may be conveyed to the Empire Forestry Confer-

ence for their loyal message. His Majesty wishes all success to the Conference deliberations."

The Conference has also been greatly honoured by the receipt of a letter from His Royal Highness the Prince of Wales, President of the Empire Forestry Association, assuring the Conference of his continued interest in their endeavour to promote forestry in the Empire. A message of welcome was received from the Prime Minister of Australia, and another from the Prime Minister of Canada (Mr. Mackenzie King) wishing the Conference a like success to that which the Conference of 1923 attained in Canada.

PROCEDURE.

2. The Conference adopted a procedure similar to that which had been found to work satisfactorily in 1920 and 1923. In the first place, the progress made in forestry in the various parts of the Empire during the preceding five years was reported, through statements presented on behalf of the different authorities, and the effect given to the resolutions of the 1923 Conference was ascertained.

The Conference had before it a long agenda which had been prepared by the Standing Committee of the Conference acting in collaboration with the Australian and New Zealand authorities. This was taken item by item in the course of an itinerary which included all the six States of the Commonwealth of Australia (and the North and South Islands of New Zealand.)

A large number of papers has been prepared for the Conference and useful handbooks, describing the existing forest conditions, were made available to the delegates.

Discussions were held in each of the capital cities and the sessions at which the Australian business was concluded took place at Canberra, extending over six days. (The final business of the Conference was wound up by a sitting at Auckland on the 22nd October.)

Visits were paid to typical forests in each of the States and facilities were afforded for the examination of saw-mills and other forest industries.

3. As a general rule each subject was first discussed in full Conference and, if it appeared that more detailed treatment was necessary, it was then referred to a committee for consideration and report. The principal exception to this procedure was the Committee on Australian Forestry, which was set up in Perth so that evidence in each of the States might be recorded.

The special Committees, in spite of the difficulties arising out of the extended itinerary, met on numerous occasions and gave very detailed consideration to the subjects remitted to them.

ITINERARY.

4. Among the interesting places visited by the delegates were the following :—In Western Australia the jarrah and karri forests, saw-mills and impregnation plants, the salmon gum and sandalwood forests ; in South Australia *Pinus insignis* plantations, natural eucalyptus forest, saw-mills and seasoning plant at Wirrabarra, the coniferous plantations and eucalyptus forests at Kuitpo and the eucalyptus and *insignis* plantations at Mount Burr and Penola in the Mount Gambier district ; in Victoria the Forestry school and coniferous plantations at Creswick, the *insignis* and red and white ironbark also grey box forests at Maryborough and Dunolly, the eucalyptus oil distillery near Bendigo, the forests of *Eucalyptus Regnans* and *gigantea* of the Cumberland Valley district ; in Tasmania, the stringy bark and blue gum forests of the Huon Valley districts ; in New South Wales the State forests of Lansdown, Coppernook and Burrawan consisting of good blackbutt, tallowwood, flooded gums and red mahogany, grey ironbark, grey gum and bloodwood, also exploitation and saw-mill operations at Langley Vale, and the coniferous plantations at Tuncurry ; in Queensland, the Hoop and Bunya pines and associated hardwood species at Imbil, and finally, in the Federal Capital Territories, coniferous and natural eucalypt forest.

THE FORESTS OF THE EMPIRE.

5. The total land area dealt with by the statements presented to the Conference was, in round figures, 8,587,000 square miles ;

the total forest area being 1,910,000 square miles in practically equal proportions of softwoods and hardwoods but of the total area, only 624,000 square miles (33 per cent. of the total) was classified as being at present merchantable.

The area definitely dedicated to timber production was placed at about 214,250 square miles.

The total volume of timber estimated to be standing in the forests was 185,800 million cubic feet of softwoods and 200,500 million cubic feet hardwoods or 386,300 million cubic feet in all.

The amount of timber felled annually for use is estimated at 2,000 million cubic feet. of softwoods and 1,600 million cubic feet of hardwoods, or 3,600 million in all. These figures do not give an adequate picture of the annual drain on the forests for the reasons that the supply comes from the merchantable area only and that no account is taken of the great losses incurred annually by fire and insects (particularly in the coniferous forests), and by unrecorded free grants of timber or by shifting cultivation.

PROGRESS DURING THE LAST FIVE YEARS.

6. Progress statements were submitted by 34 forest authorities, the majority prepared on the lines of the general plan drawn up by the Standing Committee. It is evident from the statements that the progress made has been generally substantial and in some cases remarkable. The degree has varied; it being natural that in those parts of the Empire in which organized forestry has been established for a long time the rate of progress should have been on a less spectacular scale than in those countries where forest services have been in existence for shorter periods. In India and Burma for example, forest technique is undergoing improvement through the application of more intensive research; the use of hitherto unused timber is expanding and progress is being made in the development of new forest industries. In Great Britain, South Africa and New Zealand there has been a great increase in the rate of planting by government agency, the combined figure for the three countries being 89,000 acres in 1928 against 23,000 acres in 1923. New forest services have been constituted (as in British Guiana and Nova

Scotia), and others are under consideration, while the staffing of the colonial services has been improved.

The above examples are not exhaustive and are given merely as evidence that the general forestry movement is advancing in directions which have been indicated by the Empire Conferences. But, while there is cause for satisfaction, there is, as will appear subsequently in this report, every reason why continued effort should not be relaxed, and it is to be feared that some parts of the Empire are oblivious to their obligations.

THE RESOLUTIONS OF THE 1923 CONFERENCE.

7. As regards the first resolution of the 1923 Conference, *viz.*, that dealing with policy, there is evidence of progress in many parts of the Empire, but there is still much to be done. It has, therefore, been found necessary again to re-affirm the principles underlying forest policy which were first laid down at the Conference of 1920.

As regards the second resolution, that dealing with softwood resources, the progress reported was also most encouraging. Practically all parts of the Empire are alive to the importance of conserving and augmenting their own resources of coniferous timber. As has already been pointed out, plantations are now proceeding on a large scale in various parts of the Empire.

The third resolution dealing with Empire trade and forest products, has received a certain amount of attention and the conference had before it the Tenth Report of the Imperial Economic Conference on the marketing of timber in the United Kingdom. It is clear that the difficulties in the way of organizing any large increase in Empire trade and forest products are not easily to be overcome.

The fourth resolution dealt with the establishment at Oxford of a central institution for forestry training and research. This has been done and the institution, which started work in 1924, has made a good beginning.

The fifth resolution dealing with the activities of the British Empire Forestry Association has been carried out. The association, pending the formation of an Empire Forestry Bureau

or its equivalent, has been able to render useful assistance to Empire forestry.

In the same way, resolution number six, setting up a Standing Committee on Empire forestry has been carried out. The committee has organized the work of the present conference so far as central direction is necessary, and has proved its worth as a connecting link between successive conferences.

The seventh resolution of the 1923 Conference dealt with investigations into forests products and urged that immediate steps be taken to establish in Great Britain a well-equipped forest products' laboratory. Such a laboratory has been established at Princes Risborough and is carrying on excellent work.

As regards the eighth resolution—forest fire protection in Canada—the conference was informed that while the losses from fire are still very great, considerable progress has been made.

As regards the ninth resolution—silviculture in Canada—it appears that little progress has as yet been made.

The last of the effective resolution of the 1923 Conference, *viz.*, number ten, dealing with shifting cultivation, has received attention in tropical countries, to which it is mainly applicable. While a certain amount of progress has been made in dealing with this difficult subject, it is clear that the problems connected with it have been by no means solved.

DISCUSSIONS OF THE CONFERENCE.

The following is a brief synopsis of the discussions on the subjects which came before the conference:—

8. *Forest Policy.*—The main elements of forest policy were laid down at the first conference in 1920. In connection with those principles, it has been learnt that the procedure adopted in the reservation, or dedication, of forest land has generally been standardized, the normal processes of demarcation, subdivision for management and the preparation of working plans following in due course.

Some emphasis has been laid in the discussion on the need for considering forestry in its national and imperial aspect, rather than as a matter of provincial or local concern, and it is indeed the case that such a principle is followed, in effect, in considerations of this

conference of matters of timber supply and so on. The view advanced is that central governments should be interested in matters of policy, except where they are constitutionally precluded from so doing, laying down the policy and being concerned with control in matters of legislation, management, the alienation of reserved forest, the recruitment and training of superior staff and research. No interference in petty detail is contemplated.

It has been suggested that legislation should provide for the protection of water sources and the prevention of erosion and shifting cultivation, matters which the discussions show to be of prime importance in many of the concerned countries. Similarly it was thought that governments who have not hitherto done so, should take power by legislation to assume, on conditions, the management of private forests in the public interest in certain circumstances.

Attention was drawn to the importance of providing for local supplies, a long sighted view being taken of the expansion of requirements, by the reservation or afforestation of areas near centres of consumption and to meet agricultural requirements and, in this connexion, it was suggested that the importance of this matter would sometimes justify the use of land fit for agriculture for this purpose.

The management of local or communal forests came under review, it being considered that such forests should be under the management of trained officers working under a Forest Department, whatever might be the destination of the profits of working.

It appears that in some countries the practice obtains of placing the Forest Department in charge of an officer of another department, for example, the Agricultural Department, a practice which was strongly condemned.

The question of the education of the people as on the aims and utility of forest preservation was touched upon.

AUSTRALIAN FORESTRY.

9. The report of the committee appointed to go into this question was productive of a lively debate. It was discussed in

considerable detail, and it was decided to add a section giving a short history of Australian forestry, another emphasizing the importance of reserving areas for the production of firewood, and a third emphasizing more strongly the importance of recognizing the principle of the sustained yield.

The question of silvicultural research was also debated at some length, the proposal that a Commonwealth Forestry Bureau should undertake the encouragement and co-ordination of research in the States being called in question in certain quarters; but when the functions of such an institute were described in detail, and after hearing the views of those with experience of the working of such an organization, the proposal was accepted.

(*To be continued.*)

THE BEST CUSTOMERS OF THE FOREST DEPARTMENT.

The value of the indigenous wooden sleepers purchased by the principal Railways in India* during the year 1927/28 was Rs. 273·1† lakhs. The value of the timber, other than sleepers, was Rs. 138·6 lakhs; so the total purchases by the principal railways of indigenous timber amounted to Rs. 411·7 lakhs during 1927/28. These figures do not represent the total purchases of timber by all Railways, as the H. E. H. The Nizams Guaranteed State Railway, the Jodhpur Railway, and all second and third class Railways are not included. On the other hand the timber is not all purchased from the Indian Forest Department as considerable quantities are purchased from States and private forests.

The average gross revenue of the Forest Department for the quinquennium 1919—20 to 1923—24 was 551·7‡ lakhs

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*These include only the A. B , B. & N. W., B. N., B.-B. & C. I., Burma, E. B., E. I., G. I. P., M. & S. M., N.-W., R. & K., and S. I. Railways.

†Figures taken from the Report by the Railway Board on Indian Railways for 1927-28, Vol: II.

‡Figures from the Annual Return of Statistics relating to Forest Administration in British India for the year 1923-24.

and the gross revenue for the year 1926—27 was Rs. 619·6 lakhs. It is therefore abundantly clear that the Railways are, generally speaking, the best customers of the Forest Department.

The market for wooden sleepers is, however, one that can not be retained without a struggle. The value of the metal sleepers purchased by the same Railways during the year was Rs. 259·7 lakhs. Reference to this and the relative costs of wooden and metal sleepers has already been made in a leader in the *Indian Forester* for August 1928.

The use of miscellaneous timbers, other than teak, for carriage and wagon construction and repairs is slowly but surely growing in importance. A kiln seasoning plant to deal with 3,000 tons of converted material annually is now under construction at Lillooah on the East Indian Railway, and should begin to function early in 1929. Apart from this many Railways are now taking much more interest in miscellaneous timbers. It is interesting to find that 49 per cent. of the timber used by the N.-W. Ry., at Lahore, 53 per cent. by the B.-B. & C. I. Ry., at Bombay, and 44·5 per cent. by the M. & S. M. Ry., at Madras, in their carriage and wagon shops consist of species other than teak. Many Railways, however, find it difficult to procure their timber in regular quantity and quality. Before much can be done to expand in this direction it will be necessary for the Forest Department in each Province to develop the exploitation of miscellaneous timber and to get into closer touch with the local Railways. The purchase of teak has been for so many years such an easy matter that Railways do not realize the difficulties involved in starting the exploitation on a large scale of a timber hitherto little used. Also Railways can not and will not purchase timber in small lots scattered all along the line often at very remote stations. These difficulties, can, however, be overcome, and there is little doubt that the Forest Department will do what it can to suit the convenience of its best customers.

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AGRICULTURE AND FORESTRY IN INDIA.

PART III.

(*Continued from pages* 3-9 *January number*, 1929.)

It is interesting to quote an opinion from an entirely different source. The following statement was made by Mr. Nagpurkar of the Union Agency, Poona (Manures) and was printed in the Bombay Volume :—

> "The farmer must have some source of cheap fuel in order to enable him to apply the cattle dung to the land which is so much in need of organic manure. The only possible and the nearest source of fuel is the forest. Some arrangement is therefore necessary to open this source to him. He used to get free fuel from forests long ago and there is no reason why it should not be made available now. The present forest policy must be changed. Safeguards can be adopted against destruction of timber growth.
>
> In India, to increase the grain crops means, in addition to other things, to increase the material for fuel as a substitute for cow-dung, as the stubble could very well be used for fuel. To increase rainfall and to decrease erosion as well to help saturation of moisture in the subsoils, also to prevent silting up of rivers, afforestation is an absolute necessity. But the forest policy must be changed. The Forest Department ought not to be considered as a revenue-making department but as a department to help agriculture from all points of view."

The Chief Conservator of Forests, Bombay Presidency, made rather a curious remark. He said, "We have as much under our control as we can manage". But, if, as we believe, forests are a very great asset to any province, we should get hold of as much land as we can and then increase our administrative and subordinate establishments accordingly.

Another witness in Bombay said :—" Another recommendation we wish to make is that besides timber, more extensive cultivation of shrubs or small trees which may be found to be useful for cheap fuel either as wood or charcoal may be undertaken.

One more thing which we wish to bring to the notice of the Commission is that, in many places, in dry tracts cultivable land or land near rivers has been occupied by forests because originally these lands may have been fallow. But now that cultivation has increased, it is felt that lands which are cultivable should not be kept under forest. They may be sold to the cultivators of the village by public auction and other lands which may be waste land or which may have become useless lands may be taken up for the growth of forests."

Apparently the witness did not feel that he was contradicting himself within a few lines.

The question of the influence of forests on the water or rain supply is closely bound up with the advisability of making fuel plantations. The exotic (eucalyptus) plantations of the Nilgiris are famous and it may be news to some forest officers that the Nilgiri plantations have been proved to be directly responsible for regulating and increasing the precipitation of moisture. We quote from the written evidence given by the Inspector-General of Forests :—

" *The Influence of Forests on Rainfall and storage of water in India.*—The extent to which forests increase humidity and rainfall in a country and regulate the distribution of water has been the subject of many enquiries in India and in other countries. In Dr. Voelcker's report he notes, on page 30 (2nd edition) as follows :—

'Taking all the months of the year except June, July and August (which are excluded because the rains of this period are not local in origin, but are those of the south-west monsoon and come from a distance),

it was found that during the tree-less period 1870-4 there was a total of 374 rainy days only, whilst during the wooded period 1886-90 there were 416 rainy days. Further than this, it was ascertained that the character of the rainfall had altered within late years. Light and regular rain showers taking to a great extent, the place of destructive occasional torrents. The agricultural importance of these facts is very great indeed.'

I have obtained from the local forest officers data for more recent years and we now have the following figures :—

Period.	Excluding June, July and August.
1870-74	374 rainy days.
1886-90	416 ,, ,,
1902-06	467 ,, ,,
1918-22	481 ,, ,,

It thus seems clear that the number of rainy days in the Nilgiri Hills has increased with the increase of forests on those hills. On the 467 rainy days in 1902-06 the rainfall was 165 inches; on the 481 rainy days in 1918-22 the rainfall was 177 inches."

In the report by Dr. Voelcker quoted,* there will be found clearly and convincingly set forth the extent to which agriculture in India can be assisted by forestry. The report has not received the attention it deserves from any one in India, although it was first published 35 years ago. It is surely the business of the Forest Department to press for the extention of forest areas in British India, and we may again quote from the note by the Inspector-General of Forests :—

"There can be no doubt that the agricultural communities of India would benefit very greatly indeed by an extension of the forest areas. The general humidity and distribution of rain would be improved and the

* Report on the Improvement of Indian Agriculture, by J. A. Voelcker, Ph. D., B. A. 2nd edition. Superintendent, Government Printing, Calcutta, 1897.

supply of water increased and regulated: timber and fuel would be available for the villager and he would be able to put cattle manure on his fields instead of burning it; the provision of good grazing and fodder would be increased. It will probably be difficult to obtain the necessary funds for the establishment of these desirable forest areas from Provincial revenues, and it may therefore be considered whether it is not possible to provide for them by means of loans. As regards the management of these forest areas, it would appear advisable that this should, to begin with at any rate, be in the hands of the Forest Departments of the Provinces. Forest villages and panchayets have had a certain amount of success in some parts of India, but there is no doubt that for the present greater progress in the establishment and management of forests of the class required will be made if they are in the hand of experts and not in the hands of local bodies whose members are usually at present unable to realise the immense benefits that may ensue from continuous skilled management."

The "Pioneer" of the 21st November 1928 has the following sensible article on the cowdung question:—

A PLAIN DUTY NEGLECTED.

SAFEGUARDING OF MANURE SUPPLY.

The Basis of all Agriculture.

Whether it is the increasing of the food supply of the cattle, the improvement of the crops or the general uplift of the people that the Royal Commission is considering, it has terribly handicapped itself in its deliberations by its neglect of one great possibility of improvement already existing but neglected or perverted in nearly every village in India.

It is a truism that is obvious to everyone that if the village refuse and sweepings, the human ordure and the dung of the cattle could be made to reach the fields as manure, the health of the people, the fodder of the cattle, and the quantity and quality

of the crops would benefit to an almost incalculable degree, and the solution of every problem of rural India would be vastly facilitated.

The best, however, that the Royal Commission can say about the practice of depositing all village sweepings and refuse in pits is that "there is no reason why efforts on similar lines should not be made in other parts of the country" while as for the custom of using cow-dung cakes for fuel the Commission can only say "no satisfactory alternative has been suggested where coal and wood are dear" and where wood is cheap "there is often a definite preference for this form of fuel."

If the Commission had one plain duty before them it was to insist absoultely and without exception and with all the force at their command that all cow-dung must go back to the fields as manure and that no improvement in village life and agriculture was possible till the pitting of rubbish, sweepings and ordure was universal. This was the one pronouncement that everyone in touch with village life was confidently expecting and the failure of the Commission to give India a lead in this vital matter is an absolute disaster.

Even the use of dung cakes for the burning of lime is not condemned by the Commission and no attempt whatever is made to go into the question, analyse it and discover possible ways out of the difficulty. Even had no remedy been immediately forthcoming, the plain duty of the Commission was to lay it down definitely and finally that Government must know no rest till it had rescued the cow-dung for the fields and cleaned up the village and or rather taught the villagers to do so themselves.

As it is, the most vital problem of Indian agriculture will continue to be neglected and anyone who realises its importance and tries to solve it or to urge Government to solve it will be silenced by a reference to the report of the Royal Commission.

The pity is the greater, as the problem is by no means insoluble. Pits are easy to dig and no cultivator who has reaped a couple of harvests from pitted manure will ever be content with anything else, while the reduction of flies and the improved

health of himself and his family will be too obvious to go unnoticed for long. As for the use of dung cakes for fuel, it is little use for the Commission to issue an eloquent appeal for uplift when a large part of the working day of every village mother has to be devoted to their manufacture.

There is admittedly a shortage of fuel but if the Commission had tackled it in the spirit in which they tackled the problem of the fodder supply of the cattle, a great deal could have been done. Much fuel is even now wasted by the villages but that would only replace a fraction of the cow-dung. There is no need to use cow-dung for burning lime and all good engineers prefer their lime to be otherwise produced.

The possibilities of coal and coke were never examined by the Commission. Most of the dung cake fuel is used for simmering milk for the manufacture of ghi; what would be the reduction in fuel consumption if cream separators were used? England was using dung cakes for fuel as late as 1800. She solved the problem, and so must India, but she will never do so by shirking it on the example of the Royal Commission.

The value of cow-dung as manure is many times its value as fuel and once the farmer has learnt this he will be as anxious as we are to aviod wasting it in the kitchen. He will religiously preserve all his manure and will as soon think of burning his clothes or the roof over his head as of burning his all-precious manure. It is once more a question of intensive propaganda to enlist the active co-operation of the villager in finding substitutes for cow-dung as fuel.

All agricultural problems sink to insignificance in comparison with that of safeguarding the manure supply. Manure is the basis of all Agriculture. Good bulls are useless without good food for the cattle; good food requires good manure. Good seed and good ploughs are useless without manure to strengthen the soil.

This chronic starving of the soil is the main cause of the deterioration of the cattle and of the small yield of the fields and is at the root of India's poverty. There is a large quantity of

manure being wasted or used as fuel in every village in India and it is the first duty of every farmer and of every agricultural department and of every person interested in the welfare of India to leave no stone unturned, no avenue unexplored, to secure this manure for the fields.

(To be continued.)

THE RATE OF INTEREST IN FORESTRY.

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PART II.

(*Continued from pp.* 10—20 *January* 1929 *issue.*)

Given, however, a fixed rate of interest, the Government will have to debit to the general revenues the same annual charges to meet the loan, provided a sort of sinking fund could be created to meet the liability. Thus, to meet the loan of Rs. 13,500 which will amount to Rs. 95,940 in 50 years at 4 per cent. compound interest any of the following methods may be adopted :—

	Rs.
1. Annual sinking fund to provide for Rs. 95,940 at the end of 50 years	628·4,
2. Sinking fund to meet Rs. 13,500 at the end of 50 years : 88·4; plus simple interest on Rs. 13,500: Rs. 540, at 4 per cent. ...	628·4.
3. Annuity at 4 per cent, ...	628·4.

The total amount of money paid by taking recourse to any of the above methods is Rs. 628·4 x 50 = Rs. 31,420 only, which by spreading it over 50 years meets the liability of Rs. 95,940. This is effected by the creation of a sinking fund which yields compound interest on the annual charges. The loan may also be discharged by paying simple interest at 4 per cent., Rs. 540 annually for 50 years and at the end of this period the loan itself. There is yet another method of providing for the loan which

consists in paying off 1/50th of the capital annually, plus simple interest on the unpaid capital. The total payments by various methods would amount to as under (7):—

Table II.

Method of repayment.	Capital.	Interest.	Total.
A. Sinking Fund Methods :—	Rs.	Rs.	Rs.
1. Annual sinking fund ...	13,500	17,920	31,420
2. Sinking fund to meet the loan and simple interest thereon.	13,500	17,920	31,420
3. Annuity	13,500	17,920	31,420
B. Other Methods :—			
4. Simple interest method ...	13,500	27,000	40,500
5. Instalment method	13,500	13,770	27,270
6. Compound Interest Method ...	13,500	82,440	95,940

19. It will be seen that by far the cheapest method of repaying a loan is by means of instalments. It may also be added that instalment loans are very unpopular, since nobody likes his investments returned back to him by annual instalments which must again be invested elsewhere. It is, therefore, not surprising that instalment loans scarcely ever succeed in attracting capital unless a high rate of interest is associated with them. Repayment of loans by annuities are similarly unpopular since the capital involved is paid back to the creditor in annual instalments. No investor really cares for a loan which implies the breaking up of his capital. Annuity loans, not unlike the instalment loans, could only be successfully floated at a higher rate of interest than ordinary loans. It may be generally stated that the method which is convenient to the debtor is correspondingly inconvenient to the creditor and *vice versa*. The debtor can not have the convenience in the repayment of his debts without paying for it in the form of increased interest, which makes the proposition attractive to the creditor. Although, the compound interest

method is by far the best proposition for the investor, but its attraction is considerably minimized owing to the capital being locked up for a number of years. The investor always likes his capital available in the time of his need. Compound interest investments are, therefore, not so attractive as they would appear, and as such do not imply any material reduction in the rate of interest. Methods of repayments of loans which involve the *independent* creation of sinking funds, however convenient and cheap they may be for the debtor, have nothing to do with the creditor. These methods have therefore no influence on the rate of interest. The burden of profitably administering a sinking fund lies on the debtor and it is he who reaps the profits which enable him to provide for his liabilities in a cheap and convenient manner. The Government of a country which raises a loan for afforestation work need not bother itself about the creation of a sinking fund at all. The newly created forest is enough to meet the liability at compound interest. The State loans are, however, usually raised on the simple interest principle. The interest is distributed annually to the creditors and the capital is paid back at the end of a specified period. This is the more expensive method, as we have seen above, (vide table II), but being convenient, as it is to the creditor, it attracts capital at a comparatively lower rate of interest. The proceeds from the forest investments will provide, not only the capital to be paid at the end of a given period, but also the compound interest on every annual payment made by the Government to its creditors as simple interest.

20. Having discussed the financial aspect of forestry we may now proceed to examine the influence of forests on the general welfare of a nation. The incidental benefits which accrue from a well conceived forest policy are as important as they are difficult to evalutate in terms of the current coins of the realm. A distinction must, however, be always made between forests which are economically sound and those which are a losing concern. Whatever may be the incidental advantages of the latter, no consideration other than that of direct profits should govern forest economics. The incidental benefits come

within the domain of the forest policy. A great deal of confusion is often caused by not keeping forest economics distinct from forest policy. While the perpetuation of inaccessible and unprofitable forests is not justified from the economic point of view, the government of a country may choose to preserve them or even to afforest new valueless areas for reasons quite distinct from economic considerations.

21. Thus, for example, the expenditure incurred in the preservation of the inaccessible forests in the Himalayas may be economically unsound, and yet they must be maintained as a safeguard against the floods in the densely populated plains which will undoubtedly increase, both in frequency and intensity, if these high mountains are allowed to be denuded of their forest growth.

22. Again, the Government of the United Provinces have invested large sums of money in afforesting the arid Jumna ravines to prevent erosion and consequent loss of valuable agricultural lands, and to provide incidentally cheap fodder and fuel to mitigate the effects of a bad famine. This expenditure of public money, indefensible as it is from considerations of direct profits, finds its sanction in the national rather than forest economics. For, it is cheaper for the State, in the long run, to sacrifice the interest on its investments and even a portion of the capital itself, if necessary, in the Jumna scheme, rather than to lose valuable agricultural lands and to leave the populace unprovided for in the time of a famine. Similarly, the expenditure incurred in the maintainence of the unprofitable Himalayan forests falls far short of what the State will be called upon to provide in the shape of the relief to millions of people in the plains at the time of floods which, if uncontrolled, will cause untold miseries and considerable damage to property. What is, therefore, a highly uneconomic proposition from the forest economist's point of view may be an eminently sound national investment.

23. The duty of the forest economist lies, however, in acquainting the State what direct profits, if any, a forest scheme is likely to yield. The calculation of the forest per cent. of

both the protective and productive plantations should therefore be carried out along the same lines. It is for the national economist to judge the indirect benefits and to decide whether an uneconomic forest scheme is a sound national investment from considerations other than that of direct profits. The State usually takes a broader view of things than the forest economist and chooses the course which is more profitable for the general welfare of the people in the long run. As a rule the prevention is always cheaper than the cure. The expenditure on army, education, hygiene and public health brings no direct profits to the State, nevertheless it is an eminently sound national investment as a security against social chaos and prevention against disease. Protective forest plantations may be similarly financed by the State from considerations of security which they afford against erosion and severe famines. The indirect profits which accrue from such plantations more than make up for the deficiency in direct profits.

24. The Government of a country should, however, be made fully cognizant of the extent of loss which a protective forest scheme involves. Thus, for example, if the Jumna afforestation scheme in the United Provinces does not promise to yield more than 1 per cent. compound interest, it is open to the Government to decide whether it is prepared to sacrifice 2 per cent. of interest on the invested capital in consideration of indirect benefits which the afforestation scheme is likely to confer upon the locality. The individual usually sacrifices a part of interest on his investments in Insurance companies which in return cover him against risks to his life. It is not unreasonable to expect from the State to forego a part of the interest on its investments in protective schemes which provide security against calamities. The exact knowledge of the loss helps the State in comparing afforestation as a means of preventing erosion with other alternatives including the alternative of not providing against erosion at all. If it is cheaper for the nation to lose valuable agricultural lands on either side of the Jumna every year and if famines could be averted more cheaply by creating a sinking fund for the purpose than by afforesting

the ravines the Jumna scheme would be thoroughly unsound. In other words the preventive measures adopted to avert a calamity should not be more expensive than the calamity itself.

25. To sum up, it might be generally stated that all forest expenditure should be financially sound. The national capital invested in afforestation schemes should yield a rate of interest not less than what the State pays on its loans. For an individual the average bank rate provides a standard with which to compare the forest rate. All rates should be calculated on value basis and must represent the average of the rate of interest which obtains over periods as long as are involved in forestry. Protective and other unprofitable plantations are essentially the concern of the State, and should be governed by forest policy rather than by forest economics. The State should be fully cognizant of the loss it incurs in adopting a particular policy with regard to forestry. This loss should be weighed against the indirect benefits which a proposed afforestation scheme is likely to confer on the general welfare of the nation.

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HILL TAUNGYAS IN THE KURSEONG DIVISION, NORTH BENGAL.

The statement given below shows the procedure adopted in creating plantations in these hills by the *taungya* method.

Much has been written on the subject in various Working Plans, Indian Forest Records (see Vol. VIII, Part IV, 1922), and in the *Indian Forester* (see page 71 of Vol. LIII, No. 2, for February 1927) etc. It is, therefore, considered that it may be found more interesting to give only the actual facts and figures in a tabular form, chiefly for the information and guidance of Range Officers.

The elevation at which this work is going on varies from 5000 to 7000 feet. The *taungya* system was started in 1919. About 95 acres are clear felled and planted annually, the total area under *taungya* plantation now being 952 acres. Felling and conversion into timber, firewood and charcoal is done by the forest villagers (working under the Coupe purchasers) on payment. There is a ready sale for everything.

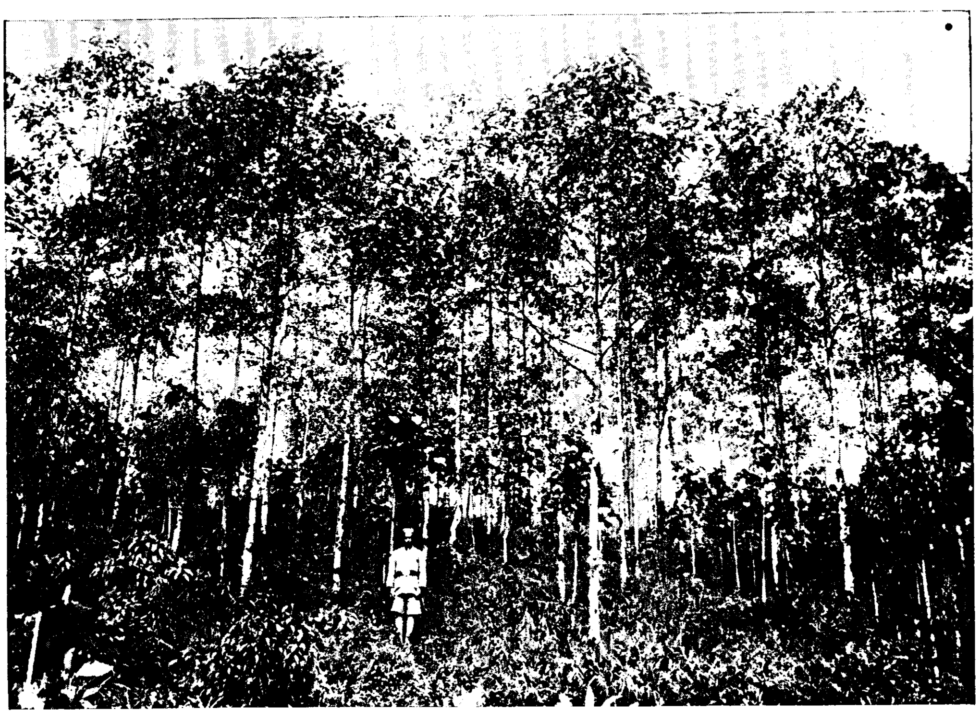
Taking a 6′ × 6′ plantation our actual cost up to the tenth year inclusive comes to Rs. 35-14-0 per acre. This includes Rs. 10

Kurseong Division, Bengal, Kurseong Range—Mahaldaram Block, Compartment IV. 1927-28 Coupe. Elevation 6,500 feet. Area 40 acres.

1. Clear felled area—Note-Logs, Stacked Firewood, Kilns for burning Charcoal, Saw-Bench, Sawn timber, and staking for transplanting in fore-ground.
2. Note High Forest in back-ground. (Photo. taken in May 1928).

Kurseong Range, Kurseong Division, Bengal. Villagers' crop of Indian corn all over the area and also the rows of stakes in lines 6' apart ; at each stake young seedlings have been planted. Period—June 1927.

Kurseong Range, Kurseong Division, Bengal. 1926 Plantation planted in June 1926 with seedlings about 8" high.
Note alternate lines of Utis (large) and Pipli (small)—(Alnus nepalensis and Bucklandia populnea), all 6' apart; in the back-ground is the 1920 Plantation. Period—June 1928.



Kurseong Division, Bengal. Kurseong Range—Dhobijhora Block.

1. 1920 Plantation—Elevation 6,000 feet. Area 9 acres.
2. Mixed plantation of Utis and Pipli in alternate lines 6' apart and 6' apart in the lines. Average height 25 feet, girth 1' 6". (Photo. taken in June 1928).

paid as *bakshis* for fully stocked plantations. If we had to spend money for the items of work done free by the villagers, the total cost per acre would be Rs. 54. Thus there is a saving of Rs. 18-2-0 per acre, which in itself is not an inconsiderable gain. But our chief gain lies in the immense superiority of *taungya* plantations over regular ones.

Mr. Shebbeare in his article on "Cost of Plantations in North Bengal" in the *Indian Forester* for April 1928 gives the total cost per acre to be Rs. 17 which, however, did not include the sum of Rs. 10 paid as reward. Taking this into account his figure comes to Rs. 27 against the present cost of Rs. 35-14-0 per acre.

T. M. COFFEY, I.F.S.,
D. C. F., Kurseong, Bengal.

Cost of taungya Plantations in the Hills, for species such as *Cryptomeria, Utis (Alnus nepalensis), Pipli (Bucklandia populnea), Champ (Michelia Champaca and exelsa), Kapasi (Acor Campbelli), Toon (Cedrela Toona), Lali Kawla (Machilus Gammieana), Katus (Castanopsis Hystrix) and Walnut.*

No.	Details.	Cost per acre.	Month.	REMARKS.
		Rs. a. p.		
	1ST YEAR.			
1	Clearing and burning the Coupe, and doing a light hoeing for first cultivation. (Potatoes sown in February and harvested in May, Bhutta sown in March and harvested in September.)	Free	February ..	By Forest Villagers for their own field crops. If the area is unsuitable for cultivation, such as Jhoras and very steep areas, Forest Department pays half the cost *i.e.*, Rs. 3.
2	Making a contour inspection path 2′ wide @ 5-8-0 a mile.	0 4 0	February...	By Forest Department. Must be done before the villagers sow their potatoes.

No.	Details.	Cost per acre.	Month	REMARKS.
		Rs. a. p.		
3	Staking 6′ X 6′ or 6′ X 4′ according to species and elevation, (includes cutting, carriage and fixing.)	Free	May ...	6′ X 6′ for fast growing species, and low elevations; 6′ X 4′ for slow growing species, and high elevations. By Forest Villagers. (Stakes at least 4′ above ground).
4	Carriage of plants from nursery.	Free	...	By Forest Villagers. If the nursery is more than 2 miles, Forest Deprtment pays carriage at the rate of 6 anna per cooly load of 400—500 plants.
5	Planting	Free	June, when rains break.	By Forest Villagers.
6	(a) Nursery cost, 6′ X 4′ planting.	13 0 0	...	Done by Forest Department.
	(b) Nursery cost, 6′ X 6′ planting.	8 12 0	...	
7	Notice Boards (Notice Boards are stencilled; the Board itself is painted white, and the species, area and year stencilled black Stencilling gaps filled in free-hand.)	...	July, after planting.	Done by Beat Officer.
8	Tending	Free	See Remarks Columns.	Tending done by the villagers in conjunction with their crops.
9	Tullying, and building earth round each seedling at base of stem	Free	September	By Forest Villagers when they remove the Bhutta stems.
10	Repairing inspection path @ 1-8-0 a mile.	0 1 0	November...	By Forest Department.
11	Second Cultivation, between the lines of seedlings, leaving 1′ round each seedling free of cultivation.	Free	January—February ...	By Forest Villagers for their own field crops. (Potatoes sown in January and harvested in May. Bhutta sown in February and harvested in August.)

No	Details.	Cost per acre.	Month.	Remarks.
		Rs. a. p.		
	2ND YEAR.			
1	Weeding whole area (for Bhutta and seedlings) and re-staking	Free	1st half July	By Forest Villagers Stakes at least 4′ above ground.
2	Filling in blanks, and carriage of plants	Free	Do.	By Forest Villagers.
3	Nursery cost of seedlings for (a) Filling in blanks in 6′ X 4′ area. (b) Filling in blanks in 6′ X 6′ area.	3 4 0 2 2 0	... ...	By Forest Department.
4	Tending	Free	See Remarks Columns	Tending done by Forest Villagers in conjunction with their crops.
5	Tullying, and building earth round each seedling at base of stem.	Free	September..	By Forest Villagers when they remove the Bhutta stems.
6	Clearing and repairing inspection path @ 3-0-0 a mile.	0 2 0	November..	By Forest Department. (Before D. F. O's inspection for rewards.)
7	Repainting Notice Boards (Notice Boards are stencilled; the Board itself painted white, and the species, area and year stencilled black. Stencilling gaps filled in freehand.)	...	Do.	By Beat Officer. (Before D. F. O's inspection for rewards.)
8	Re-staking, sickling and creeper cutting (before D. F. O's inspection for rewards.)	Free	December...	By Forest Villagers. Stakes at least 4′ above ground.
9	Rewards to Villagers for (a) Plantations fully stocked and (6′ X 4′). (b) Plantations fully stocked and (6′ X 6′).	15 0 0 10 0 0	January ... Do. ...	3/- extra for non-cultivated areas, such as Jhoras and very steep ground.
	3RD YEAR.			
1	Sickling and creeper cutting, and cutting and collecting stakes for and filling in blanks.	3 8 0	1st half of July.	By Forest Department. Stakes at least 4′ above ground.

No.	Details	Cost per acre.	Month.	Remarks.
		Rs. a p.		
2.	Nursery cost of seedlings for (*a*) filling in blanks in 6'x4' area (*b*) filling in blanks in 6'x6' area	1 8 0 1 0 0	... ...	By Forest Department.
3.	Weeding round small, also newly planted, seedlings ...	1 12 0	1st half September.	Do.
4.	Clearing and repairing inspection path @ 1/8/- per mile	0 1 0	November.	Do.
5.	Repainting Notice Boards ... (Notice Boards stencilled; the Board itself is painted white and the species, area and year stencilled black Stencilling gaps filled in freehand).	...	November.	By Beat Officer.
	4TH YEAR.			
1.	Thorough sickling and creeper cutting	3 0 0	2nd half of July.	By Forest Department for pure Utis, only creeper cutting and sickling Asilukata necessary at 0-8-0.
2.	Clearing and repairing inspection path @ 1/8/- per mile ...	0 1 0	November.	By Forest Department
3.	Repainting Notice Boards ... (to be stencilled; the Board itself is painted white, and the species, area and year stencilled black. Stencilling gaps filled in freehand.)	...	November.	By Beat Officer.
	5TH YEAR.			
1.	Sickling Asilukata, and creeper cutting.	1 0 0	1st half of August.	By Forest Department.
2.	Clearing and repairing inspection path @ 1/- per mile	0 0 9	November.	Do.
3.	Repainting Notice Boards (to be stencilled; the Board itself painted white, and the species, area and year stencilled black. Stencilling gaps filled in freehand.) ...	...	November.	By Beat Officer.

No	Details.	Cost per acre.	Month.	Remarks.
	6TH YEAR.			
1	Prunning double leaders, creeper cutting, taking out unnecessary coppice shoots and sickling Asilu-taka	2 8 0	September.	By Forest Department.
2	Clearing inspection path at 1 per mile ...	0 0 9	November.	Do.
3	Repainting Notice Boards (to be stencilled ; the Board itself painted white, and the species, area and year stencilled black, Stencilling gaps filled in freehand	...	November.	By Beat Officer.
	7TH YEAR TO 9TH YEAR.			
1	Clearing and repairing inspection path at 1-0-0 per mile	0 0 9	November.	By Forest Department.
2	Repainting Notice Boards (to be stencilled ; the Board itself painted white, and the species area and year stencilled black. Stencilling-gaps filled in freehand	...	November.	By Beat Officer.
	10TH YEAR.			
1	Clearing and repairing inspection path at 1-0-0 mile	0 0 9	Before thinning.	By Forest Department.
2	Repainting Notice Boards (to be stencilled ; the Board itself painted white, and the species, area and year stencilled black Stencilling gaps filled in freehand) . ..	...	Before thinning.	By Beat Officer.
	Thinning and creeper cutting	1 8 0	November	By Forest Department.

NOTE—Next thinning and creeper cutting, 15th year.

A NOTE ON MECHANICAL TRANSPORT AND SKIDDING OF FOREST PRODUCE IN THE SOUTHERN CIRCLE OF BOMBAY PRESIDENCY.

PART II.

In the last note principally the methods of transport of timber from the forest or 'dastan' depots to the sale depots and thence to the purchaser or consumer were dealt with. In the present note it is proposed to describe briefly the methods of extraction of heavy lumber from the stump to the forest depot.

The chief method of extraction has so far been and still is the bullock cart; *i.e.* the cart is taken right down to the stump and the log is carted from thence to the depot. But this is feasible only in flat or more or less undulating country. For steeper cross slopes and rougher country bullocks and buffaloes working in teams of two to four pairs drag the log from the stump to the nearest cart track whence it is loaded on a cart. But for still steeper slopes as in the Western Ghats most of the timber is slid down earth slides with the help of elephants. From the bottom of the slide to the depot the method of transport is either by water or by cart depending on the nature of the country and the facilities available for one or the other mode of transport.

But there are certain tributaries of Kali Nadi in which the floating of timber is not possible. In such localities even if the timber is slid down into the valley with the help of elephants it cannot be transported further on account of the very difficult and bouldery beds of such streams. Therefore the only possible method of extraction for the timber growing on such slopes is to pull the logs uphill to the plateau and thence transport them to one of the above-ghats sales dopots at railhead referred to in the last note. For moderate slopes and for small sized logs this pulling uphill is practicable by means of a team of buffaloes and judicious use of block and tackle. But for steeper slopes no method other than elephants and mechanical skidders appears possible. Elephants can work only in areas where the water supply is plentiful and for uphill dragging the slope of the

hill-side should be gentle enough for the elephants to get a firm foothold. In the Nagjhiri Valley where the mechanical skidding is now done both these conditions are absent. The hillside slopes are as steep as 42° to 43°; and 35° may be considered as an average cross slope for this valley. Except at the bottom of the valley, no water is available during the working season in any of the nallas feeding the Nagjhiri main stream. Nagjhiri is one of the tributaries of Kali Nadi and the forests on its steep banks are probably the only piece of virgin teak bearing forests in this Presidency. In previous years the timber was marked for felling and was advertised over and over again for extraction by contract. But no contractor was willing to come forward to undertake the work within economic costs of extraction. Subsequently, the question was referred to the Forest Engineer of this Presidency in 1923. After careful enquiry and thorough consideration of the local difficulties and the methods of working involved, mechanical ground skidding was decided upon.

The following outfit was purchased for the work in 1923-24:—

(*a*) Fordson Tractor (agricultural type)..... ....1.

(*b*) Peacock skidding winch (suitable for coupling with the above)................ ....1.

(*c*) Duplex geared animal power skidding winches (for working with buffalo power) ....2.

(*d*) Necessary wire rope. tripline blocks and other logging tackle etc. etc.

The work was started in the working season of 1923-24 and the results were most encouraging. In the first instance in order that local labour and staff may get familiar to this kind of work very great care was taken and no hauls over 1,000 feet were attempted. The width of the Nagjhiri valley from the ridge to the stream is over 4,000 feet in some places and in order to bring all timber within range of haul of these skidders it was necessary to construct a road from the ridge down into the valley. But subsequently the construction of this road proved to be very expensive; and it was found necessary to devise some other means of haulage up to a range of about 3,000 feet without the

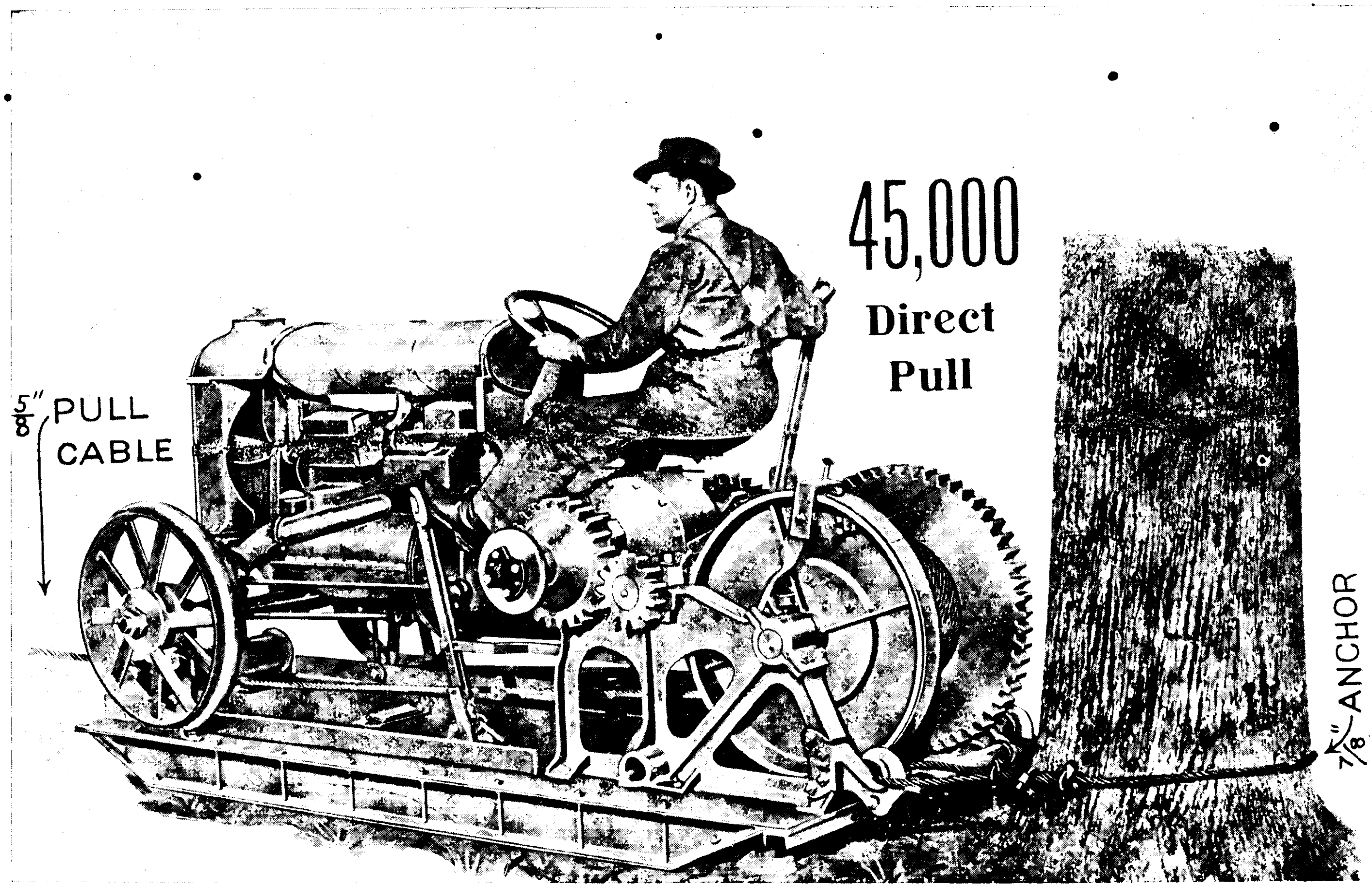
help of a road. Accordingly 'long-haul' experiments were carried out in 1926-27 and 1927-28 with rather successful results. Hauls up to 2,700 feet by means of a single tractor and long-hauls up to 3,100 feet by sending down one tractor along a specially constructed path and working the two skidders in relay were successfully tackled. The heaviest log dealt with in this skidding was $2\frac{3}{4}$ timber-tons, the average volume per log being nearly $\frac{3}{4}$ timber-tons.

For long haul work it was found necessary to purchase a second skidding outfit. Therefore in 1925-26 a second outfit consisting of a latest model Fordson tractor and one New Model Tom Huston skidding winch was purchased. The second outfit was better than the first outfit in several respects and its drum could take nearly 2,000 feet of 5/8" wire rope while the first outfit took only about 1,000 feet of rope.

The Fordson tractor of agricultural type is selected for the work. The B. H. P. developed by this tractor at its normal speed is nearly 20 horse power. The tractors run on kerosene fuel; the starting being on petrol. The consumption of fuel for a six hours day work varies from 4 gallons to 6 gallons per day depending on the load. Five gallons per day per tractor is the average consumption. The lubricants of suitable grade recommended by the makers are used.

The Peacock winch and the Tom Huston winches are designed for timber skidding work and they are specially constructed for being coupled with a Fordson tractor. The rear wheels of the tractor are removed and the tractor is mounted on the winch platform gearing with the winch drum. When the outfit is to be shifted to the next position the tractor hauls the winch (which is mounted on a pair of wheels) to its new position. While skidding the whole outfit is anchored to the base of a strong tree.

The Fordson skidders principally operate on steeper slopes and for longer hauls; the shorter hauls and upper reaches of the valley being usually tapped by the animal power skidding winches mentioned above. The Duplex geared animal power winches are manufactured by Messrs. American Hoist



FORDSON SKIDDING OUTFIT.
(With Tom Huston Winch).

Photo. by T. K. M.

The animal winch in action.

Note the large flat space required for operating this winch and the guide sheave in the fore-ground.

and Derrick Company. The motive power is a pair of buffaloes. The accompanying photograph shows such a winch in action. The work is very strenuous and therefore two pairs of animals are maintained for this work. In hot weather one pair works in the forenoon and the other pair in the afternoon. The action of this outfit is very slow and it requires a fairly large flat area for its setting. The range of action is limited to a little over one thousand feet. The drum of the Duplex winch takes about 800 feet of 5/8″ rope; but longer hauls are manœuvred by the use of suitable lengths of tag lines. On the other hand the outfit is so simple that local labour can be easily trained to look after it efficiently. At present one animal winch outfit is working under a Forester in Nagjihiri valley and another animal winch outfit is working under a Ranger on Kaneri river slopes of West Kanara Division.

The main skidding cable for both the animal and power skidders is 5/8″ diameter galvanised steel wire rope of 6/19 construction with the actual breaking load of 13·7 tons. The ropes are thoroughly examined every year before the work starts and all weak and worn out ropes are rejected.

The work is of a risky nature as logs are skidded up along slopes where a human being can hardly get sufficient grip to balance himself. Six coolies, one maistry and one overseer come up with the log which has to be kept constantly under control and prevented from taking charge down the slopes in case of any accident due to failure of the rope. Great skill and experience is required in selecting suitable turning points for the main drag line and for the selection of suitable trees for anchoring the tripline blocks. Under no circumstances is the rope allowed to rub against the ground anywhere on the line.

For work of this kind an efficient and simple system of signals is essential. The following system of semaphore signals has been adopted. The usual signals are 'pull' ... raise one arm over the shoulder

'stop' ... raise two arms over the shoulder

'slacken the rope' wave both arms in front.

At each turning point of the rope, far back on the convex side of the cable, a signal cooly is stationed in such a position that he is seen both by the signal cooly immediately above and below him. The first signal cooly is just in front of the driver of the outfit and the last signal cooly is visible to the crew in charge of the log being skidded up.

In order to reduce all possible obstruction to ground skidding special drag paths are cleared and all bamboo clumps etc. along the path are removed. The men who come up with the log keep it under control by means of peavies rolling it when necessary from one side of the drag path to the other in order to avoid any obstructions like projecting stones, tree stumps, etc, that may be in the way. The same men drag down the rope on the return journey and fix it to the next load. Heavy logs are pulled up one at a time. But in the case of light material two to four pieces are hitched to the end at one time. At each turning point on the main line the rope passes through a sheave block which is anchored to a strong tree about three or four feet above the ground level. When a log reaches such a turning point the 'pulling' is stopped and the rope is slackened in order to release the cable from the block. This waste of time is inevitable in such skidding. A special trip block which could release the cable under tension was tried but did not prove successful as the reaction of the tension in the cable threw the block with such force against the anchor tree that the sides of the block were bent irrepairably. On the head-tree next to the skidder the trip block is fixed about 12 feet to 15 feet above the ground. This tree is guyed for stability and strength. The cable leaving the skidder drum passes through a guide sheave fixed at ground level before reaching the trip block on the head-tree.

Ground skidding is the cheapest method of extraction under local conditions. The fellings are carried out under a method of selection cum improvement marking and therefore the lumber is lying scattered all over the compartment and in all sorts of places; the intervening area being full of trees and thick growth of bamboos and other undergrowth. The timber chiefly extracted is teak.

Photo. by T. K. M.

Scene—A flat ledge on a long spur.
Two small logs hitched to the end of the cable.

The following crew is required for the skidding outfits :—

Power skidding outfit.		*Animal winch outfit.*	
Overseer ...	.. 1	Ranger or Forester	... 1
Maistry ...	... 1	Maistry or Driver	... 1
Driver ..	... 1	Coolies (Male)	... 10
Coolies (Male)	.. 10	Coolies (Female)	.. 6
Coolies (Female)	... 8		——
	——	Total	... 18
Total	... 21 hands all told.		

The female coolies are principally employed for clearing skid paths and for signalling and other light work. The male coolies do the more arduous work of coming up with the log and taking back the main line cable for hitching on to the next log. When all the logs within the range of the skidder from one setting are hauled up the outfit is taken to the next setting. It takes half a day to change the setting of an outfit. The overseer with the help of the maistry selects suitable positions for the setting of the outfit and lays down the alignment of the drag paths with due consideration to the position of the logs in the valley and the location of suitable trees for trip blocks for the main cable. This requires much experience and judgement and the success of a day's work depends greatly on the proper selection of anchor trees and the alignment of the drag paths. The outfit works about 6 hours per day. From 9 A. M. to 12 noon and from 1 P. M. to 4 P. M. The labour camp is about 3 to 4 miles from the site of work at a suitable spot, usually an old deserted village site, where water supply of some kind is available.

The average output of a Fordson outfit for a good day's work for hauls up to 1200 feet is about 8 timber tons. For hauls from 1200 to 2,000 feet an output of 6 tons per day should be considered good work. For the animal winch the average output per day for hauls up to 1000 feet is over 4 timber ton. Naturally the output is affected by the steepness of slopes of the hillsides and local obstructions like boulders and precipitious nalla banks etc.

The accompanying graph shows at a glance the working costs per timber ton for mechanical power skidding for various length

of hauls. The figures include all charges on account of stores, labour and renewal of working parts of machines etc. For supervision charges and overhead charges on account of depreciation and interest and the charges on account of annual overhauling of the outfits, the figures are given in the foot note. These should be added to the figures obtained from the graphs for obtaining total skidding costs per timber ton.

The following is a summary of the financial aspect of the operations for the last working season (1927-28). The working season is from November to May of the following year. But for arriving at the true working costs the overhead charges for the whole year, including the pay and allowances of the overseer maistry, drivers, etc., for the slack season, are taken into account.

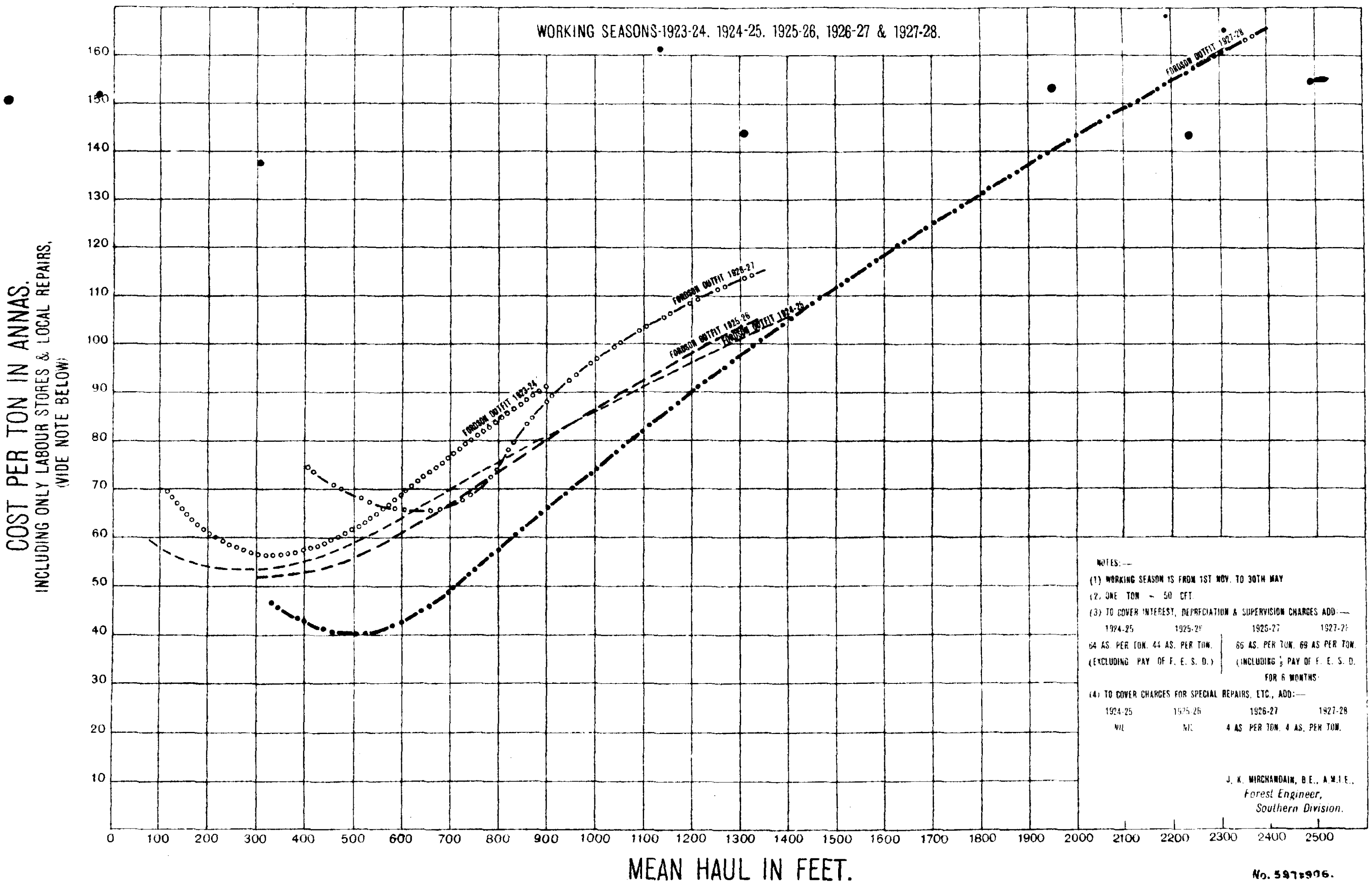
I. Skidding costs per timber ton (of 50 cft.) by Fordson mechanical skidder: Average length of haul 850 feet: Maximum length of haul 2000 feet :—

	Rs.	a.	p.
Labour, stores and repairs	4	1	0
Interest, depreciation and supervision charges (for the whole year)	4	5	8
Establishment charges for the slack season ...	0	7	3
Total including all charges ...	8	13	11
or say ...	9 per ton.		

II. Skidding costs per timber ton (of 50 cft.) by Animal power winch. Average length of haul 700 feet.—
Maximum length of haul 1000 feet.

	Rs.	a.	p.
Labour, stores (feed of animals) and repairs ...	3	5	5
Interest, depreciation and supervision charges (for the whole year)	6	12	10
Establishment charges and feed of animals for slack season	0	6	6
Total including all charges ...	10	8	9
or say ...	11 per ton.		

ANALYSIS OF COSTS OF LOG SKIDDING IN NAGJHIRI VALLEY.



Comparing these costs with the skidding carried out with the help of elephants which costs on an average Rs. 4-8-0 per khandy *i.e.* Rs. 18 per timber ton it is apparent that the mechanical power skidding is nearly half as cheap as elephant skidding. But bearing in mind that elephant skidding is impossible in the locality where the mechanical skidders are now operating and if the power skidders had not been introduced the timber growing in this locality would have remained unexploited for a very long time to come and possibly deteriorated in quality and value, the net profits to the department on account of the introduction of these skidders are roughly estimated as follows :—

	Rs.	a.	p.
Cost per timber ton of 50 cft. for felling and conversion	7	8	0
Cost per ton for power skidding from the stump to the nearest cart track... ...	8	14	0
Cost per ton for carting from the forest to the sales depot at Dandeli ...	21	0	0
Total exploitation charges per ton ...	37	6	0
or say ...	40	0	0

Average sale value of Nagjhiri teak at Dandeli is over Rs. 120 per ton. Therefore net profit including royalty is over Rs. 80 per ton.

On an average 1500 timber tons of teak have been fixed as a provisional annual yield from these compartments. Therefore the net addition to the revenue of the department due to the introduction of these skidders is as much as Rs. 1,20,000 per annum.

T. K. MIRCHANDANI.

Forest Engineer, Southern Division,

Bombay Presidency.

AN ENCOUNTER WITH A PANTHER.

SIR,—I have been asked to give an account of the accident that I met with in March last in one of the sal forests of Una Tahsil in Hoshiarpur district, Punjab, so that it might be of some use to those interested in shooting.

On the afternoon of March 21st I was out on an inspection accompanied by a Forest Guard when from a distance I caught sight of a pair of panthers drawing towards me on a ridge in the forest. I had my 12 bore D. B. B. L. Hammerless gun with me with a few cartridges in my pocket. Quietly I managed to climb up a *Ficus bengalensis* tree close by but my Forest Guard ran back and along with him went my dog that was accompanying me. The pair had to pass by my tree as that being the only way for them I remained standing about 10 feet high from the ground and had hardly waited for a few minutes when the male appeared looking majestically on all sides. I fired. The bullet (lethal) hit him in the belly and went through. He jumped forward and then stood gazing all round. I tried the second shot and it (L. G.) hit him in the left shoulder. He fell down and in a fury cleared about 5 square yards of vegetation around him. I tried to reload my gun, but as ill luck would have it, it got jammed. The beast in the meantime got up and proceeded towards my tree with his head drooping. I thought my end had come. With my gun jammed I kept standing on the tree motionless like a statue and every moment was expecting an attack. Thank Heaven he did not see me and passed off just by my tree. I thought he had gone. Getting a feeling of relief I managed to open my gun with great difficulty. It was instantly reloaded quietly. Soon after I noticed my little dog coming towards my tree on hearing the reports of my gun, but having not found me any where and coming to the smell of the animal hastened back. It was all still for a while and I was thinking for the next step to be taken when suddenly I heard the shouts of a villager inquiring as to what I had fired at and who I was. At first I kept silent, but fearing he was proceeding and had actually reached the zone of danger, I shouted out to inform him of the impending danger.

Hardly did the words escape my mouth when the beast spotted me. He was sitting under a thick bush about 15 yards behind the tree. He roared and before I could turn back to shoot I found his head just touching my gun. I pulled the trigger but the bullet just touched his head. Before I could take the second shot he caught my gun in his mouth and threw it on the ground. In a moment I found my left arm firmly fixed between his front claws. I was helpless and holding one of the branches with my right arm round it. I simply resigned to fate. I cried for help and remembered all my gods but not a soul responded. Even the man to whom I had shouted out had thrust himself under a bush and was practically half dead with fear. For about three minutes the beast remained embracing me. I was bleeding profusely in arm and a flap of about $1\frac{1}{2}''$ square was hanging on my left cheek just below the eye. The climax had reached and then came the turning point of the incident. Providence sent my little dog to my rescue. Having heard my shouts he ran up to the tree and began to bark violently at the beast. The animal too was practically done up and fearing the dog dropped to the ground. But getting up soon began to move slowly away from the tree falling this way and that way. I could distinctly see about two seers of intestines hanging loosely on either side of him through the wounds of the bullet. He continued growling and had hardly moved 20 yards when he fell into a ditch never to get up again.

The noise of the incident by this time had attracted a number of villagers working in the fields close by. One of them with a sickle in his hand approached my tree in spite of my having warned him that the panther was lying close by. He however was a bold man about 50 and soon brought me down from the tree. I was unable to walk feeling week due to excessive loss of blood. A *charpai* was soon brought and I laid down on it.

Then followed the first dressing with the piece of papers containing my sandwitches and the remnants of the turban of the old man. The panther was next brought out from the ditch and side by side with me was carried to my headquarters where I reached at about 9 P.M. There the second medical aid

was administered by a Sub-Assistant Surgeon who finished his stitching work at about 3 P.M. giving me milk and whisky all the time. Next day I was removed to the Civil Hospital at Hoshiarpur about 25 miles in a lorry where I recovered after three months.

I had sustained a good many wounds on my arm and after they were cured I counted 52 on my arm and three on my face.

Panthers are increasing everyday in number in this Tahsil and for one interested in shooting my Range quarters afford a nice little shooting ground, only one need keep a couple of dogs to attract them. Last year I bagged one panther and a hyena from the compounds of these buildings.

The other day I read an interesting article in the *Indian Forester* of October 1928 under the heading "With a tiger in camera". It reminds me of a similar incident that happened in my Range quarters just three days before I was mauled. I was taking my food inside at about 8·30 when a panther rushed into the bath-room after my dog, but before I could get at my gun he was off.

HARI SINGH

9th October 1928. *E. A. C. Forests.*

CARDAMOM CULTIVATION IN SOUTH KANARA, MADRAS.

NOTICE BY RAO SAHIB K. G. BELLIAPPA, B.A., D.F.O., MANGALORE.

Nursery practice.—The best mature cardamom fruits are selected and sun dried. Four pounds of dry capsules yield one pound of seeds, two to three pounds being necessary to sow a nursery about half an acre in extent. A nursery of this size produces sufficient seedlings to plant about thirty acres.

Nurseries are made on dry fields at the foot of the ghats. No one lives in the cardamom estates permanently and a nursery needs constant attention. The field is dug up, beds are prepared and seeds sown in November-December. The beds are kept

watered during the dry weather twice a day and are protected from the sun by means *Pandals*.

Germination takes place within about two months and the seedlings reach a height of three feet by June of the second year and will then have two or three shoots on each rhizome.

Such seedlings are pulled out, root and rhizome intact, and are planted out in pits in the estate as soon as the monsoon bursts, *i.e.*, when the plants are about eighteen months old.

Planting.—Cool shady valleys in evergreen forests should be selected, carefully avoiding ridges and dry localities, as such are absolutely unsuitable for cardamoms. In the area thus selected all undergrowth and low trees up to about twenty feet in height are cut, leaving the upper storey intact and the canopy complete, for direct sunlight is harmful. The pits are dug in lines 5′—6′ apart, 10″—12″ wide and about 6″ deep. One cardamom seedling, having as many suckers and shoots as possible, with root and rhizome intact, is planted in each pit and the roots covered with soil. The pits should be completely filled, so that no water may collect in them.

Planting is done in May-June, when the nursery raised seedlings are at least eighteen months old and 2′—3′ high. Nursery stock, natural seedlings and also young suckers are used for replacing casualties. As a rule there will be no necessity to fell large trees; but in exceptional cases where the canopy is too thick, an occasional tree may be cut here and there and in the small openings thus made, natural seedlings of cardamom usually appear in November-December. These seedlings are left 5′—6′ apart and the surplus removed, when eighteen months old, to be planted elsewhere.

Weeding.—Cardamom plantations are weeded twice a year, once in May-June, when all undergrowth is cut, and again in August-September, in order to clear the ground to facilitate picking.

Harvesting.—Picking commences in September and last until December. Only ripe fruits, or those about to ripen, are picked.

Marketing.—The fruits are dried before sending to market. Those gathered in September-October, when there is rain, are dried in sheds on earthen platforms, kept hot by fire underneath. During this process the fruits are kept continuously stirred.

Fruits gathered after the rains are dried in the sun. The market for cardamoms has been very fluctuating during the last thirty years. During the war the price dropped to about Rs. 10 per maund of 28 pounds at Mangalore, the pre-war price being about Rs. 40 per maund. In 1926 the price went as high as Rs. 125 and at present is about Rs. 95 per maund. The only market in the Division is Mangalore.

Yield.—Cardamom plants begin to bear in the third year after planting and continue to bear well from the fifth to the tenth year, after which the yield tends to drop. Though the plants last for about twenty years, it is best to renew them once every fifteen year. When renewing a plantation new pits are dug between the old ones. A good estate, when in full bearing, yields up to one maund per acre, the average yield being about half a maund per acre. The yield is dependent on seasonal rains; early showers in March-April are considered favourable.

Cost of formation and maintenance.—Experienced cardamom planters were consulted as to the costs of formation. Each one gave a different figure. The correct estimate seems to be about Rs. 40 per acre, including supervision and cost of seedlings up to the third year. When the plantation begins to yield the outlay per acre would be about Rs. 60 per acre. Maintenance costs about Rs. 10 per acre of area under cultivation. This amount includes picking, drying etc.

Pests.—Cardamom crops have a number of enemies such as frogs, crabs, snakes, rats, squirrels, centipedes etc. All these are fond of the fruit from its very early stages. The fruits are swallowed whole or the juice and the seeds are eaten.

A typical plantation.—Inspected on 23rd January 1928:—

The plantation is situated in Kombar Reserve in the evergreen forests of South Kanara and extends up to the Mysore frontier, which forms its boundary on the north and east. It is broken up by a number of perennial hill streams, descending from

ridges 2,000 to 2,500 feet in elevation. The cardamom *malai* itself has an elevation from 1,200 to about 1,800 feet.

The estate is 190 acres in extent and contains sixteen plots aggregating 62 acres cultivated with cardamoms. The plots vary in extent from 1 acre to 7 acres and are situated on both sides of the ravines, at the bottom of which flow the streams. They extend up to about two chains from the bottom of the ravines.

Picking having been completed just about two weeks previously, the plots were remarkably clean and free from dead-wood, undergrowth, and weeds, except of course shrubby growth 4″—6″ high, and contained clumps of cardamom plants up to about 7′ in height, which in well stocked areas covered the ground almost completely.

Shade afforded by the large number of evergreen trees of and above 40′ in height forms a complete canopy, so that sun rays do not reach the cardamom plants to any appreciable extent at any time of the day. The shade trees are 10′—30′ apart, the number depending on the slope of the ground. The plots contain no tree stumps, showing that no large trees were felled to clear the ground for cardamom planting. The soil is somewhat stoney aud pebbley, but very well drained.

An average clump contains about ten shoots. These were in three stages of development—(*a*) those that had just yielded and which were dead or dying, but still contained the stalks from which the fruits had been stripped, (*b*) those that were just sending forth the shoots, each from its rhizome, which bear the next crop *i.e.*, of 1928, and (*c*) young suckers about two feet high, which will yield in 1929.

About 3,800 acres of the ghat forests of South Kanara Forest Division, inaccessible from a timber extraction point of view, have been leased out for cardamom cultivation. Only about one sixth of this area has been cultivated with cardamoms in patches. This brings a revenue of about Rs. 1,300, the leases running continuously for thirty years. The estates are demarcated and surveyed.

PRESERVATION OF THE FAUNA OF THE EMPIRE.

[The following letter and pamphlet is published in extenso, for the information of our readers and we hope those who are interested will join the Society. Ed.]:—

The main objects of the Society are to ensure that beautiful and rare species of living creatures shall, so far as is possible, be saved from extermination.

We are in close touch with the British Colonies and Dependencies and it is no exaggeration to state that owing to exploi-

tation for personal gain and unreasonable slaughter by thoughtless persons equipped with the latest resources of modern civilization, the survival of many species is seriously threatened to-day.

It forms no part of our programme to interfere with legitimate sport conducted in accordance with provisions of the laws locally enacted to control this branch of human activity, neither do we wish to obstruct economic development, for both are compatible with the existence of wild life.

It is realised that permanent improvement can only be effected by enlisting the sympathies of the general public in Great Britain and in the overseas Dominions and Dependencies, and educating it to realise its responsibility with regard to the heritage of wild life with which Nature has endowed each country. We desire, for instance, to induce the people of each country to insist on the formation of suitable sanctuaries where the natural fauna of the particular region can be perpetuated. This has been done with great success in Africa, where a marvellous National Park has recently been declared in South Africa, and also there are National Parks in Canada, and many Colonies possess reserves which have not yet reached the status of National Parks; but much work remains to be done in this direction.

Our function is to collect information, to tender advice, to afford publicity to the state of affairs in various parts of the Empire, and to make efforts to educate public opinion on this subject.

To attain these objects it is essential to make our membership as wide and as influential as possible. We therefore appea to all who may be in sympathy with the preservation of wild life, whether at home or abroad, to join our Society. The subscription is kept as low as possible (*viz.* 10s.)—(Life Membership £20), in order to attract a large membership, but we shall be glad of additional help from those who can subscribe on a more liberal scale.

J. STEVENSON-HAMILTON,
Secretary.

Pamphlet issued by the Society mentioned above:—

The Passing of Wild Life.

(1) *Why Wild Life is Vanishing.*—

A scientific philosopher has described this era as the close of the age of mammals. Travellers, photographers, sportsmen, naturalists and conservers of wild life from every part of the world, from Canada, from the United States, from Greenland, from Alaska, from Asia, from India, from Malay, from Europe, are crying out the warning that wild life is being destroyed at a far greater rate than it can reproduce itself.

Birds of the air, the leviathans of the sea, the warm-blooded creatures of the land are attacked continually and relentlessly by what Hornaday called "the regular army of destruction"; by means of firearms, by poison, by traps, by nets, by sportsmen, by collectors, by trade and vested interest, all of which could, if we chose, be so rigidly regulated that no species need be exterminated.

Owing to facilities of transport and more effective methods of killing, the fur trade, whaling trade, plumage trade, and the trade which supplies the gourmet have increased; well nigh all the world is nowadays readily accessible without great hardship; there are even so-called sportsmen who conduct their *chasse* from motor cars, thus adding to the bag with a minimum of personal exertion. And as if this were not enough, there are some who shoot "big game" from aeroplanes!

As well as this we have those forces of destruction which are involved in the inevitable spread of civilisation. The breaking up of land, the draining of swamps, the felling of forests, a variety of operations all more or less unavoidable but which, in many cases, by the adoption of protective measures and the creation of National Parks, need not result in the total extermination of wild life. It is not from inevitable causes that so many species are dwindling before our eyes but from reckless and in many cases organised slaughter. It is these forces of destruction whose havoc must be checked if wild life, in anything like Nature's wonderful variety, is to be saved.

(2) *The Interests of Reasonable Sportsmen and Agriculture not damaged by the Formation of National Parks.*

It is not from the legitimate sportsman who shoot within the legal limit, and if there be none, scorns to shoot from the motor or to take an unfair or undue advantage of his opportunity to slay, that danger to the threatened species comes. On the contrary, these true sportsmen have been among the foremost protectors, and it is owing to their keenness and understanding that many of the present day sanctuaries have been established.

Further, the help and goodwill of landowners and farmers has been of assistance to the rational preservation of various species.

The Society realises the complexity of the problem of preserving certain species near farming operations, but without putting animals before essential human interests, much can be done by the formation of Reserves to obviate loss to colonists from predatory incursions of game and to preserve for the future generations the great asset of the indigenous fauna.

One phase of the problem is to awaken the public mind to the necessity of speedy and efficient action for the regulation of those trades which, in order to make immediate profits, are robbing the world of its living heritage of wild creatures; further we have to enlist the services of sportsmen, politicians, zoologists and lovers of wild life of every sort, to hammer out methods by which a *modus vivendi* between human interests and those of the surviving game can be arrived at, and above all accepted, by the people in each country. The Covenant of the League of Nations requires amendment, so that questions relating to birds and beasts can be referred to it and considered by one of its Committees.

(3) *The Colossal Destruction of Wild Life, which is being Destroyed Faster than it is Reproduced.*—As an example of the rate at which wild life is being sacrificed the following statement is quoted from a recent issue of one of the leading fur trade papers; it is as follows:—

> "The needs of men, coupled with the vanity of women will soon have destroyed all the beasts of the earth. What will become of us then?"

What indeed? A terrible and undreamt-of vengeance; for the web of life cannot be so violated with impunity.

In the book "Save Australia," by Sir James Barrett, 1925, we find the following statement (page 2):—

> "Are they disappearing? The answer is unequivocal. Except in certain places where enlightened citizens have protected them they are all disappearing In no other continent has the devastation been more rapid than that of Australia."

In the same book we read that 3,000,000 skins of Australian native animals were exported to U. S. A. in 1924 by the fur trade alone.

Cherry Kearton, in his wonderful book, "Photographing Wild Life across the World" (1923), makes the following statement:—

> "I have travelled from Cape Colony . . . to the Congo, and although I was on the look out all the way, did not see half-a-dozen animals in the journey of hundreds of miles. . . . Even in Kenya, the last stronghold of the mammals, life is rapidly disappearing, and a lover of wild creatures, living, loving and roaming amidst their natural surroundings, has only a sense of loneliness in place of former joy."

In Africa many have already been wiped out. Among them are the Blue Buck, Burchell's Zebra, the Quagga, and it is common knowledge that many other species, including the Gorilla, are in pressing need of protection. In Canada we find the same miserable story. The Passenger Pigeon was wiped out of existence by a trade interest in a few years, in spite of the fact that its numbers are said, when great flocks passed, to have darkened the sky. The Great Auk, the Dodo, Steller's Sea-Cow, the Giant Land Tortoises, were swept away by the early mariners. Only at the very last moment was the Bison saved from extinction. The Musk-Ox (as a wild species) is almost gone. The Wapiti, the Caribou, the Moose are all retreating and have only been saved now by stringent protection. The Polar Bear is scarce, the

Grizzly Bear, according to Thompson Seton, "has retreated to secluded fastnesses. . . . He has changed in temper as in life, and the faintest whiff of man-scent is now enough to drive him miles away."

For, as H. M. Tomlinson says in "Gifts of Fortune" (1926):—

> "The sabre-toothed tiger of the past was a dove compared to the creature who is pleased to suppose that he was created in the likeness of his Maker. No predatory dinosaur ever equalled man's praiseworthy understudy of the Angel of Death. . . "

Man with the various lethal weapons he has devised has outstripped the tiger in his ability to slay; he can kill a whale at one blow, he has become the most terrible and the most ruthless animal in the world. He is the Gorgon whose glance turns life to stone.

Leading scientists are greatly concerned at the precarious status of the Hump-back Whale, now practically exterminated, and the Sperm Whale, harrassed to the verge of extinction by the whaling trade, and the great Rorquals are fast following in their wake. The Elephant Seal is going. The Sea Otter has for a long time been so rare that it is protected internationally by an Order in Council under the Seal Fisheries (North Pacific) Act, yet skins were offered at a London fur-trade mart in 1927. This shows that international agreements alone are not enough. If laws are to be enforced we must have vigilant, and an educated public opinion behind the experts and officials trying to save vanishing wild creatures. The fact that many of these vanishing forms are not within our own little coast-line does not remove from us the responsibility nor prevent us from checking their destruction. A passage in the work "Save Australia," already referred to, proves this. It is as follows (page 106):—

> "When 120 lyre-bird feathers (two to a tail) were offered at one plume sale in London, it was feared extinction of the lyre-bird was imminent. . . ."

And on page 141 we read:—

> "It is gratifying to know that Australia has passed laws protecting wild life from the plume-hunters, but as

> long as skins and plumes were saleable in England a certain amount of traffic resulted. In this way England connived at breaking the laws enacted in her Colonies. The Importation of Plumage (Prohibition) Act, which passed in 1921, should therefore be regarded as a measure of Imperial unity."

Thus we see we are responsible; we can help in the great work of preserving these still unappreciated but profoundly important living links with the geological past; links whose relationship to ourselves can be traced from the day of our conception to our death.

(4) National Parks Great National Assets of the Future.—As the fauna becomes generally scarcer, great assemblages in National Parks in Africa, Canada and elsewhere will become one of the greatest attractions to travel; and, further, a spirit of pride in these collections of wild fauna will inevitably grow up among the peoples of the Dominions and Colonies who have been wise enough to establish adequate parks for wild life. Let us, therefore, lose no opportunity of rousing public opinion in the Dominions and Colonies as to the importance of laying the foundation of such national assets.

We are convinced that as years pass the more it will be realised that the game belongs to posterity as much as to ourselves. Human progress must not be stayed, but all people calling themselves "civilised" must see to it that adequate areas are everywhere set aside for all the larger birds and beasts native to the soil, before it is too late.

Stuffed specimens last but a hundred years or so, and unless the living creatures are preserved, scientific and educational museums will be unable to replace their exhibits. The same thing applies to zoological gardens which must have living wild stocks to replenish gaps made by death.

Unfortunately the vast majority of men and women know nothing of "Natural History," and they are therefore inclined to agree with those who urge that the various forms of "big game" animals—Elephant, Rhinoceros, Antelope, and so on, must give way to the "March of Civilisation," as if that dreadful

"March" would be held up if their slaughter is not speedily effected. This is the sort of question which is but too often put: "What are the great Whaling Companies going to do if the frightful toll they levy on the fast disappearing species of the larger whales is restricted; what are we going to do for leather if the destruction of Zebras and other of the larger "big game" animals of Africa is checked?"

Having but a vague knowledge of the main sources of supply of such important items as oil, and leather, and more immediate interests to be attended to, when such questions are put they give a shrug of the shoulders and say they "suppose it must go on."

And there is yet another "reason" urged:—"What *does* it matter if these animals *are* exterminated? Only a very few people, sportsmen, and so on, have ever seen, or can ever see them in their native wilds, so why bother?" It must, however be realised that ease and rapidity of travel is increasing daily and journeys overseas will in the near future be as lightly undertaken as journeys to Scotland are at present.

Let us not forget it. We are the Trustees for Posterity; we do not hold the right of Life and Death in our hands to exercise as we will, to serve the ends of commerce.

The animals now in jeopardy are links in the chain of Evolution; and we are yet very far indeed from understanding the agencies which have moulded the often marvellous adjustments they display in relation to their environment, and the key to these agencies is to be found in their living bodies as much as in their stuffed skins, or skeletons; these last we must have in order that we may follow our conclusions to their logical end. The more we learn of the mysteries of Life, in all its manifestations, the better shall we understand our own bodies, and the sources and trend of that intelligence which has made Man "a little lower than the Angels."

We have no right, then, to hamper the search for "Light" of those who come after us. What would be said if it were suggested that St. Paul's or Westminster Abbey should be cleared away to ease the problem of London's traffic, or for the erection

of blocks of flats to ease the housing problem? Would it suffice to urge that the "March of Civilisation" made such vandalism inevitable?

But these are buildings made by men's hands, they could be pulled down and erected elsewhere. No man, however, can restore the dead to life.

The animals now threatend with extinction are of widely different types; so long as they can be preserved in their natural surroundings they are potential sources of knowledge of immense importance to us, and those who come after us. Let us not then recklessly and callously destroy what we cannot replace. A grave and great responsibility is ours, and we may not lightly shirk it.

All, then, who are interested in the problems which living bodies present; from Man himself downwards; all who would know more of the Universe we live in, not merely for the sake of knowledge, but also for the sake of the greater grip such knowledge affords of the problems of Life, and of the sources of our Emotions, good and bad, should take a hand in the advancement of this Society and its aims.

The task of saving threatened species is beset with difficulties. The natural territory of some species is being unavoidably invaded by the extension of railways, consequent cultivation, and so on. The raids of other in the crops of settlers has to be kept in hand or prevented; complaints of such raids are sometimes made as a pretext for slaughter which affords a more profitable source of Income than the cultivation of nominal crops.

Hence to see that an even-handed Justice shall be meted out, both to man and beast, "Game Wardens" must be appointed and paid.

The bigger the membership of this Society the more will this good work be furthered; if only by the spread of an intelligent and enlightened attitued towards the realisation of its aims.

The Society for the Preservation of the Fauna of the Empire is doing a great work in rousing and organising public opinion on this important question. It has correspondents in the various Dominions and Colonies, and is in close touch with Societies in

other parts of the Empire, which have similar aims. It is not composed of fanatics, but is directed by reasonable people who realise the conditions produced by the opening up of new lands, but at the same time press without ceasing the importance of the creation af adequate sanctuaries before it is too late. Much has already been done by the influence of this Society, but each decade brings fresh problems, and this is no time to relax effort.

The Society has been re-organised of late under the Chairmanship of Lord Onslow, and its headquarters are in the Offices of the Zoological Society of London. All nature lovers are urged to join this body of workers. A card to the Secretary will produce particulars of membership; the subscription is within the means of all.

THE RE-CONDITIONING OF COLLAPSED HARDWOOD.

To demonstrate to Tasmanian timber producers the marked improvement in collapsed hardwood boards which can be effected by suitable kiln treatment, a badly collapsed stringy bark board was selected from the reject stack of J. Gourlay Pty. Ltd., Hobart. Portion of this board was taken to the Munitions Supply Laboratories, Maribyrnong, for treatment, the remaining portions being left with Mr. Gourlay for comparison with the treated portion.

Effect of Treatment.—The sample taken was too small for the determination of strength before and after treatment, but a series of tests made in this laboratory on mountain ash boards similary treated in the Victorian Forests Commission's kiln showed that the strength of timber is not appreciably affected by the treatment. In addition, the working qualities of the timber are considerably improved.

Conclusions.—The reswelling produced by the reconditioning treatment is satisfactory. Slightly better results might have been obtained by longer treatment.

The re-drying (29·9 per cent to 9 per cent) in two days is somewhat rapid. It is possible that with slower drying shrinkage

during this process might be less. Experience with this species of timber would be necessary before an optimum drying rate could be laid down.

Maximum rectangular cross-section obtainable from the sample before treatment = 7·9 in. × ·34 in = 2·7 sq. in.

Maximum rectangular cross-section obtainable from the sample after treatment = 8·56 in × ·59 in = 5·1 sq. in.

Net gain in dressed timber = 89 per cent.

While this experiment shows that badly collapsed timber can be reconditioned, it is noted that the occurrence of collapse can be prevented by proper kiln treatment.

R. E. SUMMERS, *Senior Chemist*,

(*The Gum Tree*, *September* 1928.)

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THIRD BRITISH EMPIRE FORESTRY CONFERENCE (AUSTRALIA AND NEW ZEALAND) 1928.

(*Continued from pages* 59—66, *February number.*)

EDUCATION.

10. Universal opinion was in favour of concentrating forestry training in a small number of really efficient schools in order that the services may count on a steady supply of recruits trained to a really high standard.

As a foundation for this technical training a broad general education is desirable since forest officers in administrative positions must be able to appreciate many factors affecting forest policy other than pure forestry.

There was considerable support for the idea of selecting recruits for services prior to technical training on the ground that this would give a wider field of selection.

The Imperial Forestry Institute has fully justified its creation, and it ought now to be put on a permanent basis; it is of particular value in providing specialist and refresher courses to officers from Empire services.

The question of forest education in Australia received special attention. Differences of opinion were expressed on general principles of forest education, but it was finally accepted that the higher education of forest officers in Australia should be concentrated at Canberra. It was universally agreed that the preliminary training in science subjects should be conducted at a university, and that the subsequent two years' course in forest

subjects, at Canberra, should qualify for a science degree. It was suggested that forest education might be strengthened in the direction of timber economics and timber marketing generally.

An interesting development in the education of school children and their parents in forest matters was outlined in the scheme for school plantations in Victoria.

FORESTRY TECHNIQUE.

11. The discussion on this subject was opened by an address on the principles of forest management. It was stated that there was nothing mysterious in forest management, and that these principles differed in no radical way from the management of a business or a farm. Starting with an elementary arrangement suited to the early stages of forest development, management became more elaborate with the increasing technique of operations and the value of forest products.

The first essentials required are survey and stock-taking, followed by a regulation of the yield. Survey has been successfully carried out from the air, and this method was recommended for wide application under suitable conditions.

Special reference was made to the regulation of the yield and its effect on the permanency of forest industries.

The standard silvicultural systems were discussed, as well as their modification and adaptation to the different silvicultural requirements of tropical and temperate forest types.

In the debate on silviculture, the importance of a study of the life history of trees, the growth and development of crops, and regeneration and tending was clearly brought out. The factors regarding natural regeneration, the conditions under which natural or artificial regeneration should be employed, and the value of mixtures was discussed.

In the case of afforestation in temperate climates, wider spacing was generally advocated, especially in the case of fast growing eucalypts and Douglas fir. In South Africa wide spacing within limits reduces costs of planting and weeding. Finally it was unanimously accepted by the conference that silviculture was the foundation on which all forest management was based, and

that management was of paramount importance in all forestry practice.

EMPIRE FORESTRY BUREAU.

12. A general desire to devise some means of collecting and disseminating information on forestry subjects was expressed; for receiving reviews, abstracts and translations of forest literature, and for keeping research workers in touch with each other. In view of the new forestry organisation which had come into being since a bureau was first mooted in 1920, delegates were disinclined to set up another institution for the purpose, it being felt that all the work required could be done by existing institutions:—

(1) Imperial Institute; (2) Imperial Forestry Institute; (3) Princes Risborough.

At a later stage the question of contributing to a Forestry Bureau in the International Institute of Agriculture at Rome was discussed in full conference, and it was agreed that it should not be supported.

FOREST PRODUCTS RESEARCH.

13. A fairly comprehensive review was made of the work which has been done in the various parts of the Empire during the last five years.

In order to make the best use of timber crop and to put forestry on the best economic basis a wide knowledge of special properties of woods and the products derived therefrom is necessary. Forest products research is still in its infancy, and has scarcely received due consideration and support from foresters.

Most large units of Empire have set up more or less fully equipped laboratories to prosecute this work or are now in the act of doing so. The smaller colonies, however, are unable to support such a laboratory, and it is suggested that Princes Risborough should be equipped to undertake the work for these on a cost basis.

It is vital that existing laboratories should co-operate in every way in order to avoid overlapping and to ensure rapid progress.

LABOUR IN RELATION TO FORESTRY.

14. The fact that forestry employs more labour than is ordinarily supposed was forcibly demonstrated in the English and the Australian papers. Under Australian conditions, with little forest work other than the utilisation of the virgin stand, it is estimated that over 188,000 wage-earners, and if families of workers are considered, over 9 per cent. of the population, are directly or indirectly dependent on the forests. Under English conditions, with a normally stocked forest and close utilisation, forests employ as much as one man to 28 acres. The organisation of forest services, the recruitment of staffs, rates of pay and conditions of work, output, and costs of out-turn of mills was discussed.

Organised forestry appears to offer opportunities for closer settlement which should not be neglected. Labour in the forest is usually carried on at times of the year when agricultural work is at its lowest ebb, and forestry can often employ more men per 100 acres than some methods of intensive agriculture.

FORESTS IN RELATION TO CLIMATE AND EROSION.

15. The Conference was of opinion that, whereas it was probable that the presence of forests had some influence on local climate, especially through the cooling of winds passing over forests, nevertheless sufficient evidence does not exist to prove anything definite in this respect.

It was probable, however, that forests were more likely to affect something in this direction in tropical rather than in temperate climates.

The damage caused by erosion in all parts of the Empire was forcibly demonstrated. The causes of erosion are—forest destruction, shifting cultivation, fire, and grazing—and the damage done consists in the erosion of hill sides, the silting up of navigable rivers, the diminuation in the perennial flow of streams, and the destruction of cultivated land by the deposition of sand and of gravel both by the action of wind and water. Concrete

instances of such destruction were given by several delegates. It was shown that while losses from these causes during the last century had been immense, the magnitude of such losses being spread gradually over a series of years often escaped public attention.

The remedies for floods were too often entrusted to engineers and involved large expenditure when only too often a better and cheaper method could be employed by the preservation of the natural vegetation clothing the watersheds of the rivers.

This led up to the consideration of the catchment area of the Murray River, and its importance with reference to the Hume Weir, and the attention of the Governments of the Commonwealth of Australia, New South Wales and Victoria were directed to this most important matter.

FINANCE.

17. The indirect benefits from forests, which benefits cannot be expressed in terms of money, are often greater and more vital than in other industries. Forestry is such a long-term investment that, if compound interest is charged, there are no other comparable investments from which to determine the rate. Many examples were given of indirect benefits which must outweigh any financial considerations, *e.g.*, the Murray catchment area scheme, but there was some difference of opinion how much the indirect benefit argument should be used when such benefit cannot be stated in definite terms.

No arguments were advanced for neglecting compound interest altogether, though some considered it should not be charged when replacing an existing forest.

There was a general concensus of opinion that the rate must be below the current rate of money. It was shown that even to assess the purely financial result of forestry, money was an inaccurate index except to forecast results, but that the value of money must be modified by index figures. The arguments put forward for a low rate per cent. were that all wealth does not in fact increase at a compound interest rate of 5 per cent., that forests increased automatically at compound interest, that they

were a form of compulsory saving, and that the products of forests were independent of variations in the value of money. The duty of the State to produce timber, independently of financial results, was touched upon.

It was suggested that all forest research institutes should pay special attention to the problem, and that a committee of inquiry might be appointed, consisting of a financier, an economist, and a forester.

PULP AND PAPER.

18. The Canadian situation shows that the increase in this industry in Canada has been very pronounced during the last few years. So much so that to-day that Dominion leads the world in newsprint production. At the same time, the demands of this immense industry on the raw material secured from the forest are causing some concern. Consequently, considerable attention is being paid in Canada to research in forestry and paper processes looking to waste eliminations, use of other species, and improved manufacturing technique. The pulp and paper industry is co-operating with the Government of Canada in the setting up of new and improved laboratory facilities for this work, which, commencing with fundamental scientific research, progresses through laboratory experiment and semi-commercial testing to mill operations of new processes.

Relief may be expected, as prices increase, from the utilisation of bamboo for the manufacture of paper pulp by chemical processes.

The Australian situation shows interesting possibilities in the research and experiment now under way, looking to the use of Australian hardwoods for the manufacture of pulp and paper. It is obvious that, if suitable processes can be evolved, not only will important industrial developments ensue, but the whole economic situation of Australia with regard to forestry and forest products will vastly improve. The principal economic difficulty is the necessity of using 70 per cent. sulphite pulp to 30 per cent. ground under Australian conditions, as against a reverse proportion where long-fibred softwoods are used, as in Canada.

TIMBER SUPPLY AND CONSUMPTION.

19. Timber supply and consumption were reviewed. It has been shown that 50 per cent. of the world's soft-wood supply is situated in North America. Special papers on the situation in Canada and on the Pacific coast, the largest producing region in the world, disclosed the fact that these timbers were largely marketed outside the Empire, whereas the United Kingdom's markets were dominated by Baltic timbers. In eastern Canada there is a marked tendency for the pulp mills to absorb an increasing amount of the produce of the spruce forest. The general discussion indicated that within the next decade or two, with the exhaustion of virgin supplies, and before our forests were placed on a sustained yield basis, a material reduction in the softwoods available for the market might be expected.

The debate on hardwoods, however, indicated that certain species of soft or light, hardwood could be utilised in place of conifers. India, Australia, West Africa, Malaya and Borneo produce these light hardwoods. The great varieties of species encountered, and the difficulty of logging, increases the cost at which it would appear that only limited quantities could be exported, and at a considerable increase in price over that prevailing in softwood markets of to-day.

FIRE PROTECTION.

20. The Canadian situation shows considerable improvement since the last Conference held in that country in 1923, particularly with reference to the more favourable public sentiment regarding the necessity of preventing forest fires. In India, controlled burning has replaced complete fire protection in many localities where the presence of fire resistant species makes such action possible.

Emphasis was laid on the fact that no fire-break can be effective in stopping forest fires under adverse conditions, although the planting of broad-leaved trees in fire-breaks is of considerable value. The primary use of fire-breaks is to provide quick access and to ensure a convenient base from which to conduct control operations.

The discussion on the Australian situation disclosed the extent to which the delegates were impressed with the prevalence of forest fires in the Commonwealth. The feeling was that the whole question of forest fire protection should be made the subject of detailed examination without delay. Obviously economic considerations will prohibit complete fire protection of the entire forest area for a long time to come. It was recognised that, in the case of fire resistant species at least, controlled burning may be necessary from a fire protection stand-point. It was felt, however, that these considerations should not be allowed to obscure the fact that uncontrolled forest fires ravage large areas of valuable timber every year, and constitute a distinct menace to the future prosperity of the Commonwealth.

LIVING TREE AND THE FOREST.

A.—Silviculture: Methods and Lines of Research.

21. The Conference dealt in detail with the organisation of research. It was generally agreed that research work in silviculture was best localised, but that local research work should be co-ordinated at central institutes. A central institute was best adapted to the working up of statistical data supplied by local branches and, in consultation with local branches, with standardising the lines and methods on which research on silviculture and statistics should be carried out. Every forest department should have its own silvicultural research branch, and to secure continuity all research should be carried out in close co-operation with the local executive forest officer. With regard to the supply of highly qualified men for research posts, it was pointed out that much of the routine work, more especially in statistical work, could be carried out by men of a lower grade of training, provided this work was guided and supervised by highly-trained officers.

The Conference dealt with the necessity of close co-operation with scientists in allied branches, more especially in research in soil biology and the botany of forest trees.

Finally, the record and publication of research work was considered of importance, so as to ensure continuity, prevent overlapping, and keep foresters in touch with the work being done.

B. and C.—Entomology aud Mycologv.

Dr. Swaine opened the discussion by dealing with the difficulty in obtaining the right type of man for entomological research, and emphasised the importance of co-operation between the different branches of forestry and research officers in entomology. He proceeded to give in some detail an account of various insect attacks and the lines on which each problem had been dealt with. The discussion which followed showed that the discovery of parasites inimical to the insect pest provided one of the most suitable methods of control. An instance was given of the success of silvicultural treatment in dealing with fungus attack. The importance of research into the mycorhiza effecting the growth of the exotic conifers was mentioned, and the meeting was warned of the danger of pests in large areas of conifers—especially *P. insignis*—and against the possible importation of bark beetles from overseas. With regard to staff employed on entomological and mycological research, officers employed in such research should be given the general education of a forest officer and should have at least a few years in the executive branch of the forest department.

Resolution No. 1.—Forest Policy.

This Conference re-affirms Resolution No. 1* of the British Empire Forestry Conference of 1920, and urges those Governments which have not already acted on these to do so without delay.

* This resolution reads as follows :—

1. Forest Policy.

" In view of the great importance of the Empire as a whole, as well as to each of its component parts, of producing a sustained yield of all classes of timber, of encouraging the most economical utilisation of timber and other forest products, and of maintaining and improving climatic conditions in the interests of agriculture and water supply, each of the Governments of the Empire should lay down a definite forest policy to be administered by a properly constituted and adequate forest service.

2. *Survey of Resources.*

The foundation of a stable forest policy for the Empire and for its component parts must be the collection, co-ordination, and dissemination of facts as to the existing state of the forests and the current and prospective demands on them.

3. *Constitution and Status.*

In order to attain continuity in the development of forest resources it is desirable that certain elements of stability be secured in the constitution of the forest policy. This may be done by the following measures :—

(1) The definition (where this has not been done already) of forest policy in a Forestry Act or Ordinance.

(2) The reservation for the purpose of economic management and development of forest land under conditions which prevent the alienation of any which is primarily suitable for forest except for reasons consistent with the maintenance of the forest policy as a whole.

(3) The assurance to the forest authority of funds sufficient to carry out the accepted policy for a series of years.

(4) The grant to members of the forestry services of the status of civil servants with due provision for pension.

(5) The appointment as the chief officers of the forestry service of persons having a high standard of training in forestry, their selection and promotion being by merit alone.

(6) The establishment in each of the larger parts of the Empire and for the Colonies not possessing responsible Government collectively, of an officer or officers, having special duties of advising as to forest policy and surveying its execution."

The Conference also desires to draw attention to certain aspects of forest policy which, although not all of universal application, are of great importance in some parts of the Empire :—

(*a*) It is of paramount importance to lay down and adhere to a definite and permanent general policy. Fores-

try has imperial and national, as well as local aspects, and forest policy, except where existing constitutional procedure directs otherwise, should be laid down by Central Government who, further, should exercise control over legislation, management, the alienation of land dedicated to forestry, research and the training and recruitment of superior staff.

(b) Forest legislation may suitably provide for the protection of water supplies for human consumption, agriculture and other purposes; for the prevention of erosion; for the control of shifting cultivation, whether on private or public land, and for the better management of private forests.

(c) Provision should be made for the dedication and afforestation of areas near centres of consumption and to meet agricultural requirements. In this connection it may sometimes be necessary to make use of land fit for agriculture.

(d) The management of forests serving local or communal purposes should be in the hands of trained staff working under the forest authority.

(e) Experience has proved that while complete co-operation between the forestry and other branches of the public service is highly desirable it is short-sighted economy to amalgamate forestry and agriculture in one administrative service.

(f) The relations of a forest department with other Government departments should be on a strictly commercial basis.

(g) Public education is required as to the importance of forests and forestry, and it is suggested that elementary instruction on the subject be given in primary and secondary schools.

(h) The Conference also commends to the notice of Governments the course of instruction in forest

policy given at the Oxford School of Forestry to probationers for the tropical African Administrative Services.

RESOLUTION NO. 2.—AUSTRALIAN FORESTRY.

This Conference approves the report of its Committees on Australian Forestry (Appendix No. 2), which it desires to bring to the notice of the Governments of the Commonwealth and of the various States for consideration and action.

RESOLUTION NO. 4.—EDUCATION.

This Conference approves the report of its Education Committee (Appendix No. 4), which deals with the training of forest officers in general and forest education in Australia in particular.

The Conference considers that the decision to set up the Imperial Forestry Institute, recommended by the Empire Forestry Conference of 1920 and 1923, has been fully justified by results. It strongly recommends that steps be taken forthwith to obtain from the Governments of the Empire such financial and other support as will place the Institute on a permanent footing and fully equip it for its work.

RESOLUTION NO. 5.—FOREST TECHNIQUE.

The Conference approves the report of its Committee on forest technique, and desires to draw attention of all Governments to the necessity of bringing their forest estates under organised management, as soon as possible, with a view to ensuring a sustained yield of forest products, perpetuating timber and other industries dependent on forests for their existence.

Further, management being dependent upon a sound knowledge of the requirements of the species, emphasis is laid on the necessity for silvicultural research.

RESOLUTION NO. 6.—IMPERIAL FORESTRY BUREAU.

This Conference, acting on an instruction of the Imperial Conference of 1926, has considered the Resolution of the 1920 Forestry Conference and the discussions by the 1923 Conference and, in the light of developments which have since taken place

now approves the report of its Committee on the subject (Appendix No. 6)

It has not been found necessary to recommend the establishment of a separate Bureau, as the work can conveniently be distributed among existing institutions.

In view of the definite benefits which will be derived by each unit of the Empire, from the organisation now proposed, the Conference recommends that all Governments give it their fullest support.

Resolution No. 7.—Report of the Imperial Economic Committee on Timber.—Forest Products Research.

The Conference re-affirms paragraph 1 of Resolution No. 3 of the 1923 Conference, and welcomes the report (C.M.D. 3,175) on timber issued by the Imperial Economic Committee with which it is in general agreement.

The Conference approves the report of its Committee on Forest Products Research (Appendix 7) and commends it to the various Governments of the Empire.

The paragraph referred to reads as follows:—

"The Conference is of the opinion that the Empire requirements of timber and other forest products should be supplied to the greatest extent from resources within the Empire."

Resolution No. 13.—Next Conference.

This Conference accepts the cordial invitation of the Government of the Union of South Africa to hold the Fourth British Empire Forestry Conference in that Dominion in 1933, and desires its Chairman to transmit to the Prime Minister of the Union a suitable message of thanks and appreciation.

Resclution No. 14.—Vote of Thanks.

This Conference desires to express its high appreciation of the arrangements made by the Commonwealth and State Governments of Australia for the conduct of its work and for the great hospitality that has been extended to delegates. But for the most successful management of the many tours undertaken, any

review of the conditions existing over the vast area of Australian forests would have been quite impossible.

Delegates have also received and desire to acknowledge with grateful thanks, the many courtesies extended by Civic and Municipal bodies. The facilities placed at the disposal of delegates by local institutions and private persons have enabled them to learn much of the trading and exploitation sides of the forests and have also been a most pleasant addition to the official arrangements.

(*To be continued.*)

FOREST LOANS AND FOREST INVESTMENTS.

One of the factors which is most frequently lost sight of in discussions of forest finance is Policy and before dealing with the subject of this note, it is as well to discuss in a general way how Policy affects Finance.

Government, as represented by the Governor in Council, is the ultimate authority for laying down Forest Policy and until a definite Policy has been formulated it is not possible for the Forest Department to design constructive management for the State Forests.

To assist Government in coming to decisions on the question of Policy, it may be necessary to submit proposals and to point out the effect of different policies. Any proposal which involves the expenditure of large sums, should, if possible, be accompanied by a financial forecast, so that Government may make its decision with as full a knowledge of the financial aspect as possible. If data are not available and in India, in particular, this is usually the case, policy must be formulated without a financial forecast, though Government would naturally ask its Audit Department to devise a method of accountancy, which would show from time to time the progress made and the cost.

Once a policy has been sanctioned, the Forest Department should be permitted to take up the work with the minimum amount of interference.

Admittedly the Finance Department may criticise the arrangements proposed for financing a forest project, but purely

destructive criticism is of no value and in a sense is *ultra vires*, because it absolutely vetoes policy and usurps the function of the Governor himself. If the financial proposals of the Forest Department are distasteful to the Finance Department they must suggest others, if policy is to be carried into effect.

Apart whatever from finance, Government has certain responsibilities with reference to Forests. We may classify forest areas as (1) Protective, (2) Timber Forests.

Government should maintain, as protective forests, such areas as are necessary to preserve water supply and prevent erosion, landslips etc. As regards its Timber Forests, it must assure itself that their total area is adequate and is correctly distributed over the country. It is failure in the past to take sufficiently into account correct distribution, that may make it advisable to re-afforest areas for the supply of forest produce to places which have no timber forests near.

We may omit from consideration existing Protective Forests, since management is not likely to be intensive and the expenditure of large sums is not usually called for.

As regards the balance we may classify the problems, with which 'finance' will be mainly concerned, as follows:—

I. The artificial regeneration of existing timber forests, where natural regeneration is inadequate or impossible.

II. The afforestation of new areas, in order to obtain certain indirect benefits, maintenance of water supply, prevention of erosion, correction of faulty distribution of timber lands.

III. The aforestation of new areas of Government Waste Lands, not required for other purposes, as a commercial proposition.

We may similarly tabulate a Forest Policy for each type of problem—a policy which for ulterior motives a political party might dispute, but one which the Governor in Council would not question.

Type I. "The maintenance and improvement of the productive capacity of those forests set aside as a permanent source of forest produce."

Type II. "The attainment of the indirect benefits with the maximum efficiency and economy and wherever possible with a full knowledge of the probable cost, should a financial loss be likely."

Type III. "The afforestation of blank areas only if it can be shown that a financial success will result."

The policy with regard to existing timber lands having been accepted, it is the work of the Forest Department to design management to give effect to the policy. One essential to the maintenance of the productive capacity of a forest is the establishment of adequate regeneration.

Generally speaking the basis of management will be natural regeneration, partly because it is the method, which imposes the least financial burden on revenue.

Cases must and do occur where regeneration fellings are made and no regeneration results, One reason may be that management is wrong ; the yield may be too high and the fellings may get ahead of the appearance of regeneration. The solution is the revision of the Working Plan and the reduction of the yield to its correct amount.

Where, however, the lag of regeneration is due to a temporary adverse factor, artificial regeneration is indicated and it is no function of a Finance Department to decide whether or not artifical regeneration should be resorted to in a particular case.

As a rule the amount of artificial regeneration required to complete natural regeneration will not be so extensive as to warrant a forest loan. If however, arrears of work make the expenditure involved so heavy that an excessive burden will be placed on Revenue and turn a Surplus into a Deficit, a forest loan is indicated. One of the chief and most useful functions of capital is its power to spread a financial burden over a series of years, and advantage should be taken of this, whenever really necessary.

The points for decision in negotiating a loan of this sort are—(1) the period of the loan ; (2) the method of repayment and (3) the rate of interest.

Definite and universal rules cannot be laid down as regards the period of the loan, because each case must be decided on its own merits. The period should be long enough to prevent annual revenue from violent dislocation, this being the whole object of the loan, and, probably, it would be advisable if the period was sufficiently long to permit of the new crop coming into partial bearing (profitable thinnings), though this is not essential. The period should not exceed the rotation and will usually be very much less. There are only two possible methods of re-payment (1) the Instalment Method ; and (2) the Annuity Method. In the former case the annual payment decreases with time and in the latter case the payments are constant. The practice of crediting all annual surplus from the Forest Department to general revenues prohibits the administration of a Sinking Fund to provide for lump sum payments of borrowed capital under the Simple Interest Method or borrowed capital and accumlated interest under the Compound Interest Method. Without a sinking fund either of these methods of repayment merely transfers the financial burden to some future year, does not, therefore, help and would not be contemplated as a sound financial measure.

The important thing to remember is that we are here dealing with a loan and not an investment and that a definite undertaking is made to return the borrowed capital and pay interest for its use for a period of years.

The rate of interest from the point of view of Government, as a whole, does not matter. If the Forest Department borrows one lakh for 30 years at 4½ per cent., it agrees to pay back under the Annuity Method of repayment a fraction of the principal and interest on the balance unpaid, which amount to Rs. 6,139 per annum. Had the loan been at 3 per cent., the annual payment would be Rs. 5,102 and the Forest Department's annual surplus would be Rs. 1,037 greater. But the revenue accruing to Government in the Loan Account would show a corresponding decrease,

the total of Forest Revenue and interest on the loan being identical.

As an extreme case the problem of regeneration of sal forests of Bengal and Assam may be quoted. Here indiscriminate fire protection in the past has to all intents and purposes prohibited natural regeneration, as a means of maintaining the productive capacity of those forests and it may be advisable to negotiate forest loans for artificial regeneration. This should, however, not be necessary so long as current revenue exceeds costs of such artificial regeneration.

It is idle to contemplate the misjudgments of the past or to argue that the new crop for which one lakh was borrowed at $4\frac{1}{2}$ per cent. for a period of 30 years cannot possibly yield three and three quarter lakhs, even assuming it were felled at this age. Such compound interest calculations are entirely beside the point and lead nowhere.

For the same reason it would be of no value for the Audit Department to keep a Compound Interest Account and to insist that a loan really only requiring a period of 30 years and the Annuity Method of repayment, should be extended to the rotation of the new crop with a Compound Interest Method and no Sinking Fund.

It may be emphasised that we are dealing with a loan, where borrowed capital is returned to the lender, and not with an investment where the capital remains to produce dividends.

We can deal with problems of type II and III together because the only difference is that with type III, the project must show reasonable grounds for a financial success, and with type II the indirect benefits must conpensate for any financial loss.

We may also include under type II the problem of the conversion of a valueless mixed forest to a more valuable one by change of species, which will usually involve the investment of capital. The point which I particularly wish to bring out is that we are dealing now with an entirely different problem, not a loan but an investment.

We have in the first place to define what we mean by a financially successful investment, and there are two common

measures of success. Firstly by dividend, and secondly by profit.

The dividend is the percentage rate of income to producing capital and a success is attained if the dividend is as good or better than what could be obtained by the investment of the capital in other spheres of equal security and attractiveness.

The profit is the excess over and above a stated rate of interest and a dividend greater than the rate of interest results when a profit is made, because the invested capital is reduced by the amount of the profit.

While admitting that in the majority of cases it is difficult, if not impossible, to prepare a financial forecast for a scheme of afforestation, it is convenient to discuss the method of preparing a forecast, in order that a system of accountancy adopted to test actual results, as opposed to a forecast, may be correctly interpreted.

A financial forecast should be as simple as possible, so that its interpretation may be easy, and in order to attain simplicity it may be necessary to make certain assumptions, which however do not greatly detract from the method.

It may now be stated that neither the dividend, the capital nor the profit or loss can be ascertained until the project is complete, in the sense that it is producing a steady income. It is therefore useless to consider one isolated plantation, and in preparing the forecast we must assume that a normal series of plantations is aimed at.

Secondly, all charges must be placed to a Capital Account. For instance, if 1 acre is to be taken in hand each year and the cost of administration is Re. 1 per acre per annum, the actual expenditure will be Re. 1 for the first year, Rs. 2 for the second year etc., etc. Such charges will however be represented in the account as their equivalent capital, which we may conveniently call the Working Capital.

Thirdly some value must be assigned to the soil, since once the project is complete the invested capital will consist of *r* acres of soil and the growing stock of a complete series. What will be the actual cash expenditure depends on whether the soil

belongs to Government; but nevertheless it forms part of the wealth, the dividend from which we are attempting to predict and it must be included in the account.

The Valuation formulae required to put up a financial forecast on these lines are very simple.

The annual debits to the capital account will be :—

Sc.........the cost or assessed value of the soil

c.. ......the cost of afforestation

E.........the working capital

For *r* years this amount must be debited annualy to the account and after crediting any revenue from thinnings etc., p. per cent. interest must be added at the end of each year.

From the *r* th year onwards, when the final yield from the first plantation is available, a steady annual income will permit of administrative charges and cost of regeneration being paid from revenue.

It simplifies the forecast to assume that costs of regeneration will be equal to the original cost of afforestation. If they are less the position will be better than the forecast. Because from this time onwards we pay annual charges from annual revenue we are entitled to credit to the account in the *r*th year the whole of the working capital, amounting to *rE*. If this is done it can be shown that the nett debit in the account amounts to :—

$$\frac{Y_r + T_a + T_b + \ldots\ldots - (c+re)}{\cdot op} - \frac{(S_e - S_c)(1{\cdot}op^r - 1)}{\cdot op}$$

Where S_e is the soil expectation value.

This represents the Invested Capital, the growing stock and soil of a normal series of *r* plantations each 1 acre in extent. The expected nett annual revenue, assuming that costs of regeneration are the same as costs of afforestation, is :—

$$Y_r + T_a + T_b + \ldots\ldots - (c + re)$$

Hence the Invested Capital is equal to the capitalised value of the expected annual income less $\frac{(S_e - S_c)(1{\cdot}op^r - 1)}{\cdot op}$

This expression is the accumulated value of a saving on soil costs annually for *r* years and is called the profit or loss, according as $(S_e - S_c)$ is positive or negative.

We thus see that a profit can result only if the soil is bought or assessed at less than its expectation value, for a given per cent.

A numerical example may make the position more clear. "It is proposed to invest capital in the conversion of a valueless miscellaneous forest, at present bringing in only 8 annas per acre, to a more valuable one by artifically changing the species. The aim is to create 40 normal plantations, each 1 acre in extent, and money can be borrowed at 4 per cent.

The following are the expected receipts and expenses :—

Receipts—

Thinning in the	15th year worth	Rs.	5 nett.
„	25th	„	20 „
„	35th	„	30 „
Final yield	40th	„	400 „
	Total gross income	Rs.	455

Expenses.

Cost of planting... ... Rs. 50 per acre.

Annual charges ... ... „ 1 per acre per annum.

Assuming that costs of regeneration are the same as the original costs of afforestation, the expected nett annual income will be :—

Revenue	... Rs.	455
Less cost of regeneration Rs. 50.		
cost of administration Rs. 40	... „	90
Total	... „	365 for 40 acres.

The aim therefore is to convert the present rental of 8 annas to over Rs. 9 per acre per annum, by the investment of capital.

The soil expectation value for 4 per cent. and 40 years works out at Rs. 19 per acre.

With money at 4 per cent. we can assess the actual value of the soil at 25 years purchase or Rs. 12-8 per acre.

Hence $(S_e - S_c)$ = Rs. 6-8.

An annual saving of Rs. 6-8 for 40 years at 4 per cent. accumulates to 6·5 × 95·025 or Rs. 618. *The profit on 40 acres is thus Rs.* 618.

The capitalised value of the steady income is $\frac{365}{\cdot 04}$ = Rs. 9,125. The invested capital is thus 9,125—618 or Rs. 8,507 for 40 acres On this capital we expect an income of Rs. 365, representing 4·3 per cent.

The proposal would therefore appear financially sound, since a profit of Rs. 618 is expected from 40 acres after 40 years or a dividend 0·3 per cent greater than 4 per cent is likely.

Had it been necessary to borrow money at 5 per cent., the soil expectation value would be Rs. 6 only.

We should, however, have assessed the soil at 20 years purchase or Rs. 10 only. The annual *loss* on this account would be Rs. 4 accumulating in 40 years at 5 per cent. to 4 × 120·8 or Rs. 483. The capitalised value of the income would amount to Rs. 7,300 and the invested capital to Rs. 7,300 + Rs. 483 or Rs. 7,783. The dividend would be 4·7 per cent.

It may be noted that the invested capital is less than before and the dividend greater than before ; and yet the proposition will result in a loss or a dividend 0·3 per cent. less than 5 per cent. The non-inclusion of a soil value in the account would, show the proposition likely to result in a profit, even at 5 per cent.

With money at 5 per cent. Government would have to decide whether the conversion was sufficiently urgent to warrant a loss of Rs. 12 per acre or whether they should wait until the rate of interest drops sufficiently to make the prospects of a loss remote. The rate of interest with which the calculation is made should be the rate at which money can be invested in other equally attractive and secure spheres.

It is, I think, failure to realise the essential difference between a loan and an investment; a forecast and a balance-sheet which largely leads us to talk about the 'compound interest bogey'. In the example there is no question of returning the borrowed capital. The increase in rental from 8 annas to Rs. 9 per acre per annum can be obtained only by the investment of capital. No further borrowing after the 40th year should be necessary to

maintain the productive capacity of this new and valuable part of our permanent timber lands.

If Government will at no time consider the conversion of comparatively valueless forests on the grounds that they will not receive back their capital plus compound interest, they have no right to include the area at its full value, as part of the permanent timber lands, necessary for the welfare of the country.

In those cases, where for want of data, financial forecasts cannot be prepared and Government accepts the policy of conversion on general grounds, the audit of accounts will eventually show what capital has been invested and what dividend results.

What particular system of accountancy would be acceptable I leave to the Audit experts. Methods similar to that outlined in the preparation of a forecast would obviously be of simple interpretation. The interpretation must however be confined to "Investments" and not to "Loans," and expressed in terms of dividend on invested capital.

It should also be emphasised that actual results would in any case differ from a forecast, even if such could be prepared, and failure to attain 100 per cent. success in any year is no excuse for summarily closing down operations; and that no real interpretation can be placed on the figures until the project actually does give a steady income.

To those, who object to including soil value in the account on the ground that no actual cash expenditure is required, I would say that perhaps the Audit experts can devise a method not requiring its inclusion. Personally I think the true state cannot be ascertained without assigning some value, except with a loss of simplicity and facility of interpretation.

Finally if Government will not accept as their policy the maintenance and improvement of the productive capacity of their forest areas, why train forest officers. American lumbermen on very short term contracts and skidders would be a howling success.

AGRICULTURE AND FORESTRY IN INDIA.

PART IV.

(Continued from pages 68-74, February Number).

We must confess that our analysis of the Report of the Royal Commission on Agriculture in India, as far as forestry is concerned, leaves us with a profound feeling of disappointment and the conviction that the members of the Commission have not risen to their opportunities. We have indicated in the previous portion of this article how the Commission has, in our opinion, failed to make the obvious and very important recommendations and we may now continue by examining their remaining proposals which are little more encouraging.

Passing by the question of forests as a source of leaf-mould for crops, we may quote the report on Forest Industries :—

"The development, by the forest departments, of forest industries is a matter of great importance to the agriculturist. We are, therefore, glad to observe that considerable attention is being paid to the commercial possibilities of minor forest products. An important section of the Research Institute at Dehra Dun deals with this work, both generally and also with special respect to the forest products of the United Provinces. The testing of the suitability of various woods for use as containers and the treatment of bamboo for the production of paper pulp on a commercial scale are two important aspects of the industrial activities of the Institute. In the Punjab, a utilisation circle has been created which is mainly concerned with the extraction of resin. Burma also has a utilisation circle, the main object of which is to get local industries to use Burma timbers for such purposes as manufacture of matches and of boxes. In the Central provinces, an officer has been placed on special duty for the investigation and study of new forest industries and the finding of markets for them. The Forest Department in Madras has a minor forest produce section and has also installed a modern plant at Olavakot, about 35 miles from Coimbatore, where woods are being tested for all purposes. Although in Bombay and

Bengal there are at present no special agencies for the exploitation of forest products, the evidence we took has satisfied us that the forest departments in both Presidencies are alive to the possibilities of, and the need for, industrial development. We consider it desirable that a forest utilisation officer should be appointed in every province in order that the development of forest industries may be made the definite responsibility of one officer.

In many cases, cultivators in the neighbourhood of forests are unable to win from the land sufficient to maintain themselves without some supplementary means of livelihood. It is clear, therefore, that, if new industries can be started, or existing industries developed, in which cultivators can participate, they will derive great benefit from them. The making of charcoal as a by-product, the extraction of turpentine, the cultivation and the processing of lac, all provide suitable subsidiary occupations. There is also scope for the extraction of essences from medicinal herbs, and of oils, gums, resins and dyeing and tanning materials from forest trees and plants. It has recently been shown by the Madras Forest Department that excellent barrels can be made from local woods. There is a potential demand for cheap wooden handles and frames for agricultural implements to be satisfied, especially if and when local factories are established for the mass production of improved implements. Many even of the lesser known Indian woods are of fine quality, their suitability for furniture and other purposes is now being investigated at Dehra Dun, and when their valuable properties have been demonstrated, new markets for them may be anticipated.

We consider that there is a wide field for both experiments and development and that, in exploiting forest produce of all kinds, it is very desirable that the forest departments should work in close touch with those responsible for the development of rural industries."

This is all very well but forest officers will no doubt read between the lines, and will wonder whether all the attempts that have been made to develop such industries of recent years have justified themselves. One thing we may say and that is that if villagers are willing to help to develop forest industries forest officers will be the first people to welcome their co-operation.

Regarding shifting cultivation some interesting remarks are made :—

" In many parts of India, the practice of 'shifting cultivation' variously known as *jhuming*, *kumri*, *taungya*, or *podu* still persists. Virgin forest is felled and burned, and the land thus prepared is cropped for two or three seasons, after which the process is repeated on a new plot.

In tracts where the population is small as compared with the area under forest, this method of cultivation, however wasteful, is comparatively innocuous, provided that it is followed by no serious erosion of the soil. Many of those tribes, whose traditional method of cultivation is by shifting cultivation, are increasing in numbers, and find it each year more difficult to discover suitable areas of forest land. We think, therefore, that the time has come when a determined attempt should be made to bring this practice under control and, by education and possibly, by an increase in the grants given towards the labour expenses of terracing and *bunding*, such as are already in force, for instance, in the Naga Hills in Assam, to persuade the people to adopt stable methods of cultivation and to forego their migratory habits. Shifting cultivation in the Central Provinces, which used to be of considerable extent, has been gradually stopped and the methods by which this was effected may be worth studying by officers faced with this problem in other provinces.

It is scarcely necessary to state that we see no objection to the controlled system of shifting cultivation described to us in Bengal, under which the necessary labour for replanting clear felled forest is obtained by allowing a certain fraction of the forest area to be placed in rotation under temporary cultivation."

" The cessation of uncontrolled 'shifting cultivation', which is recommended, should arrest further harmful deforestation in hill districts. But there is no province in India which has not suffered already, to a more or less serious degree, from such deforestation. In the Central Provinces, Assam, and Burma, the damage has not yet affected areas of settled cultivation, and, in the Central Provinces, shifting cultivation has been stopped. In the Punjab, the United Provinces, Bengal and Bombay, serious deterioration is

taking place owing to the deforestation of the Siwalik and Kumaon Hills, of the Chittagong hill tracts, and of the Deccan outcrops and Konkan hills. In regions of heavy rainfall, that is, where the rainfall is over 60 inches, the essential remedy is protection against damage by cultivators and their goats and cattle in order to allow of natural regeneration. In tracts of light rainfall, there is no generally satisfactory remedy, but, in carefully selected areas, artificial regeneration might be possible though at heavy cost".

Again we come back to the old difficulty, protection against damage by cultivators and their goats and cattle. These recommendations sound well, but do they lead to anything?

When the Commission tackles the question of 'Reclassification of Forest Lands' it appears to us that they are giving way to popular clamour. What is the use of handing over land to the villagers when all that happens is that they double their already large herds of miserable cattle? The curse of India is the herds of wretched cattle and it should be the aim of Government to reduce the herds, not to increase them. In our view the standpoint taken up in the following proposal is quite wrong because we believe that the forest department, generally speaking, makes good use of all the land under its administration and that the country will benefit by every acre that is kept under the control of the department:—

"Forty or fifty years ago, when there were forest departments, but no agricultural departments, and when the problem arising out of the pressure of population on the soil and the necessity for cattle improvement had not assumed the importance they now possess, it was natural that the forest departments should be regarded as the only departments capable of turning to advantageous use large areas of State land which were lying neglected and which were not required for cultivation. The result was that the presence of trees or scrub jungle was considered sufficient justification for notifying, as forest, land which was in reality more suited for grazing or for cultivation than for the growth of trees. We consider that the time has come when a systematic reclassification of this type of land is required. The ideal to be aimed at in all provinces is to distinguish between

land which is suitable for the growth of good timber trees or for fuel plantations (including land, the preservation of which under forests is desirable on climatic or physical grounds), land which is suitable neither for timber, fuel plantations, nor for ordinary cultivation, but may possess possibilities for development as fodder reserves and grazing grounds, and land which is suitable for ordinary cultivation.

Subject to what is said in the following paragraphs, land of the first type should, in general, be managed by the forest departments, although there may be cases in which the pressure of population is such that indifferent agriculture is preferable to reservation for the growth of timber. Land of the second class of which the forest departments still, in the aggregate, hold wide areas should no longer remain under the management of the forest departments, as at present constituted, except where the areas are so intimately connected with true forests as to make their separation administratively impracticable. Where good land suitable for cultivation is either actually under forest or retained by the forest departments with a view to afforestation, any proposal for its disafforestation will require careful examination from the point of view of maintaining a sufficiency of timber for the needs of the province."

Surely the provinces want more forest, not less? Bengal has only 14 per cent. of its area under forest, the United Provinces 5 per cent., the Punjab 7 per cent., Bihar and Orisas 4 per cent.. the North-West Frontier Province 2 per cent., Madras 14 per cent. and Bombay 12 per cent. Although British India has 23 per cent. of its total area under forest, half of the total area is in Burma, which is after all, another country.

Village Forests.—The "Indian Forester" has so often expressed itself as opposed to the handing over of Government forests to the control of villagers that the following may be quoted without comment:—

"The most promising method of establishing village forests is to be found in handing over to village management certain more or less wooded areas now under the management of the forest departments. There are many forest areas so interspersed

among cultivation as to make their conservation for the production of commercial timber impracticable if, in accordance with the declared policy of Government on the subject, the interests and needs of the local population are to be the first consideration of forest management. To the Madras Government belongs the credit of a bold attempt to interest the villagers in the protection and development of such areas by investing them with the responsibility for management, which is exercised through a popularly elected committee known as a forest *panchayat*. As we have mentioned, about 3,200 sq. miles of forest lands have already been handed over to *panchayat* management. The *panchayats* are supervised by a special *panchayat* officer who works under the Board of Revenue. The Board fixes the rent to be paid for the *panchayat* area and the number of cattle which may graze in any particular area. All other details of management are left entirely to the *panchayat*. Where the area when under the management of the Forest Department yielded a net revenue, the rent fixed is always less than this. In some cases no rent is levied and in others, it is charged for three years only. As transfers to the *panchayats* only commenced on any considerable scale in 1923, it is not possible to pronounce a definite opinion on the success of the movement but it is reported that there is a growing improvement in the protection of the reserves and in the interest taken by the villager in limiting the number of cattle admitted to them, in enforcing the accepted grazing rates and in closing the reserves temporarily to improve pasture. The Chief Conservator of Forests, Madras, expressed himself as hopeful of the future of the system and the Director of Agriculture regarded it as one of the best attempts which have been made in recent years to solve the problem of utilising forest lands to the fullest extent for the cultivator's needs. The forest administration of the United Provinces has recently placed an officer on special duty to study the Madras scheme. In the Central Provinces and in Bombay, we found opinion somewhat divided on the question whether popular management of this character was feasible and, in the Punjab, the view was taken that it would be impracticable. Circumstances differ so much in the

different provinces, both in regard to the type of forest lands available and the character of the local population, that the experiment in Madras may prove to be unsuitable for adoption all over India, however successful it may be in Madras itself. We consider, however, that the management by the people, for the people, of the forests close to their villages possesses so many desirable features that every effort should be made to ensure its success".

We again join issue with the Commission when they make the following remarks :—

"We are of opinion, however, that with the re-classification of forest areas, there should be at least an attempt—for we recognise that a sharp distinction would not always be possible—to re-classify the functions of the forest officer.

The true timber-producing forests of India and Burma are a rich possession, bringing in large revenues to the State, so that, in the public interests, they must be carefully managed; but this is not all, for, as we have seen, the timber resources of India are meagre enough, and the pressure of the world's timber supplies is increasing rapidly. Thus, in the interests of future generations, it is essential that waste should be prevented and that efforts should be made to ensure that timber supplies in the future are greater than they now are. It is with the timber forests that the work of the forest departments is, in the main, concerned; and the interests of forest officers cannot fail to be bound up in their development.

These great forests are for the most part situated in the hills; but on the plains, there are areas interspersed with cultivation, but classed as 'forest', the extent of which in the aggregate is considerable. These areas are of relatively little value as a source of revenue, but of considerable importance to neighbouring cultivators, and they are possessed of a potential value that we do not think has yet been sufficiently recognised. Because of their small commercial value, and also because the important forests give scope for all the energies of the existing forest staff, little attention has been given to the development of this second type of forest property. Nor do we think it likely that it ever will receive the attention that should be given to it unless

is placed under the management of a division of the Forest Department directly responsible for its development.

During the past half century, the population of British India has increased by some sixty-two millions or thirty-three per cent., and with this increase the time is rapidly passing when the country can afford to neglect any resources which offer opportunities of improvement. In our chapter on Statistics, we draw attention to the areas now officially classed as 'culturable waste' and 'land not available for cultivation' and we recommend that this classification be re-examined. We think it likely that within these vast areas, which together include about 45 per cent. of the total surface of British India, there could be found much land, which, though unsuited for commercial afforestation, might, if placed under the charge of a minor forests division, be used to grow fuel and provide better grazing than it now does, or might be added to the village forests, managed by *punchayats*, to which we refer above".

"We do not wish it to be understood that, in every case, the differentiation of functions which we suggest above should follow the same pattern; what we recommend is that, in each province, Government should aim at establishing two divisions to be responsible for the charge of the forests, the preservation of which is desirable on climatic or physical grounds and of commercial forests, that is, of those forests managed with a view to direct profits from the sale of timber and other forest products; the other division to be in charge of minor forests, fuel plantations, village woodlands, and waste land, now chiefly used for grazing and often included under 'unclassed forests'. Officers of this second division, in addition to the conservation of the natural resources of such areas, should be definitely charged with the responsibility of developing them, and with this object in view should be encouraged to make experiments in silviculture and in the improvement of grazing areas.

We make this recommendation not because we are able to point out means by which the extensive wastes of India can be easily improved. We believe that improvement will be difficult, and that success, without careful study and experimental work,

will not be possible. Nor do we suppose that, when means for affecting improvement are devised, the spread of improved conditions will be rapid. It is indeed, because they are likely to be slow that we recommend there should be no delay in attacking the subject. Experience in such matters cannot be gained quickly; on the other hand, as population increases, the urgent demand for action calculated to increase the produce of waste land is certain to grow. We are satisfied that a share of the attention which has hitherto been bestowed on the valuable section of the country's forest property should now be spared for, and concentrated on, the problems presented by that section of the forest land now regarded and treated as 'waste'."

We are entirely opposed to two divisions being established within the forest departments and we believe that nothing could be worse for forestry and agriculture in India. On the other hand it seems very sensible that divisional officers should have, in suitable places, assistants whose special duty it will be to watch over the interests of agriculturists near the forests and that such officers should go through a special course of training so that they may learn how best they can help the agriculturist to utilise his manure properly, to use wood fuel, to feed his cattle economically on the best grass, and to avoid waste.

If the forest departments are encouraged and allowed to do this, they will be one of the most important factors for the improvement of agriculture in India—(*concluded.*)

NOTE ON THE MYSORE WOOD TAR DISTILLATION PLANT AT BHADRAVATI.*

It may interest readers of the "Indian Forester" to know that a wood tar distillation plant was installed early in 1925, in the Mysore Iron Works at Bhadravati. The object was to produce from wood the tar, obtained from the charcoal plant, wood tar creosote (for preserving wood and for the preparation of sanitary disinfectants), wood tar pitch, and lighter oils for the manufacture of pigments, etc.

*FOOTNOTE :—This article is published in continuation of an article by the same author in the October number 1924. Hon. Ed.

The average daily production of settled wood tar from the wood distillation plant is about 6 tons, a portion of which is sold as wood tar, the rest being re-distilled in direct-fired stills. The plant, as it stands at present, can cope with about twice the present output of tar.

The mechanical equipment of the tar plant is as follows :—

(1) Two tar stills, each of 1250 gallons distilling capacity, made of steel shell, the dome being of copper.

(2) Copper condensers, the water jacket being 28″ in diameter by 6′-6″ in length.

(3) Two copper separator boxes, 24″ × 12″ × 18″.

(4) Two Taber pumps.

(5) One 10 H. P. motor.

Two recording thermometers, and tanks for the storage of the various distillates.

The well-settled tar from the field tanks, after partial dehydration in a wooden tank, is fed into one of the tar stills, where it is subjected to distillation. The early distillates namely, the light oil and acid liquor, are collected up to 195° C., and the remaining fraction of the oil constitutes the heavy oil from which a special fraction and the Mysore wood preservative are produced.

The residue in the still (after the oil extraction) is wood tar pitch in a molten condition. This is dumped into special receiving coolers from which it is barrelled, while hot, into steel drums, and allowed to solidify. The light oil and the pitch serve as the main ingredients for the manufacture of paint, and the heavy oils are further treated to yield wood preserving oils.

The heavy oil is redistilled in the same stills. After the removal of light oils and acid liquor, the distillate remaining undistilled forms the wood preservative 'B'; when the distillation is continued for the separation of the creosote fractions, with boiling point up to 235°C., the residue in the still forms the wood preservative 'A' of commerce.

It is claimed that the wood preservative 'B' satisfies the specification of the National Wood Chemical Association of the United States of America for hardwood preserving oils except as regards the specific gravity. Wood preservative 'B' has a

density of 1·04 as against 1·06, laid down in that specification. The wood preservative 'A' satisfies the requirements of the specification in every respect.

Wood or coal is the fuel used for firing, and each charge takes about ½ ton of coal or ¾ ton of wood fuel.

The acidity of wood tar has a corrosive action on the bottom of the still, so that each bottom is good for only about 60 distillations. Photographs of the general view of the plant, the outside as well as the interior, are shown opposite.

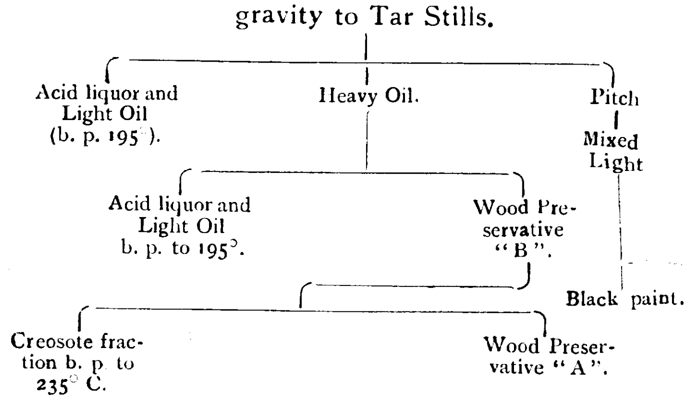
The log sheet of a complete distillation is appended to the note (*vide* Appendix I). It may be interesting to note the following average yields per ton of tar distilled last year (1927-28) :—

Acid liquor	...	...	16·0 gallons.
Light oil	...	...	33·0 ,,
Heavy oil	...	...	55·0 ,,
Pitch	...	..	·38 of a ton.

FLOW SHEET OF OPERATIONS.

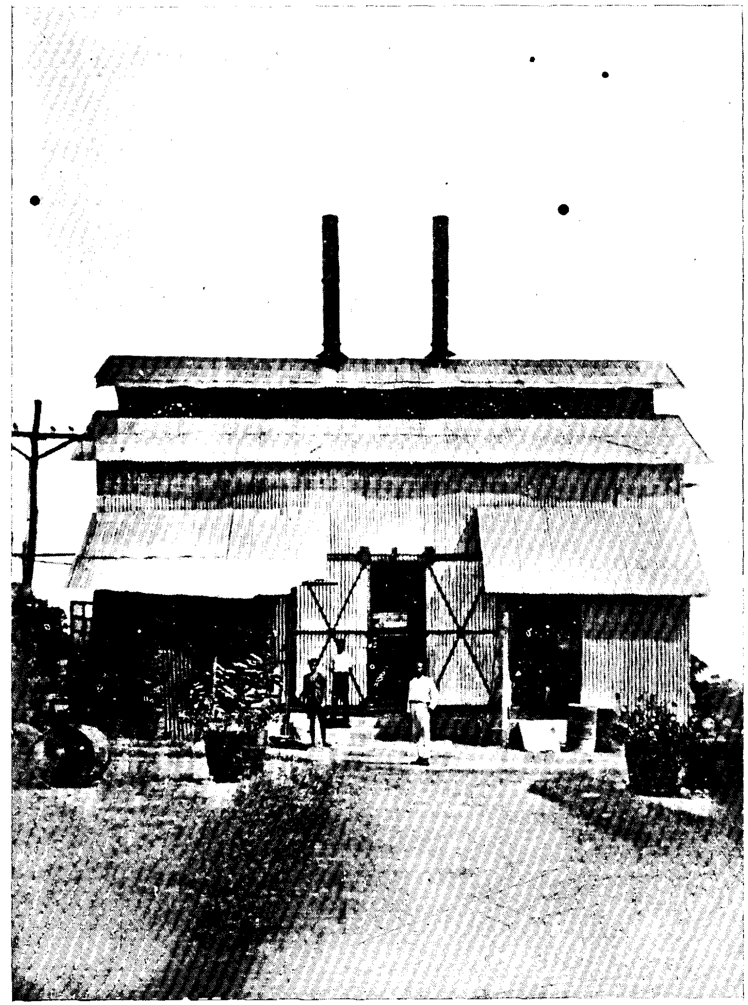
Settled Tar from Still House.

Dehydrated Tar by Dr. Clifford's patent process by gravity to Tar Stills.



The writer wishes to place on record his thanks to the Mysore Iron Works authorities for the information given in this note.

S. KAMESAM, B. E. (Mech.), M. E. (Hon .), A.M.I.E.,
Assistant, Wood Preservation Section.



Mysore Wood Tar Distillation Plant.

APPENDIX I.

COMPLETE TAR DISTILLATION.

Charged 1250 gallons of tar. Light Oil tank 6″ } Original
Time of firing—11·20 A.M. Heavy Oil tank 5″ } readings.

Distillation commenced at 2·45 P.M. @ 75° C.

Time.	Temperature in °C.	Actual and net readings of receiving tanks.		No of inches.	No. of gals.	Total gals. of distillate collected.	Remarks
4 P.M. ...	77 °C	11″	5″	5″	42·5	42·5	
5 ,, ..	80 ,,	15″	9″	4″	34	76·5	
6 ,, ...	85 ,,	18″	12″	3″	25·5	102	
7 ,, ...	100 ,,	22″	16″	4″	34	136	
8 ,, ..	115 ,,	23″	17″	1″	8·5	144·5	
9 ,, ..	145 ,,	27″	21″	4″	34	178·5	
10 ,, ..	175 ,,	32″	26″	5″	42·5	221	
10·20 ...	185 ,,	35″	29″	3″	25·5	246·5	Acid liquor & Light Oil.
Heavy Oil appeared at 10·20 P.M. @ 185°C.							
12 midnight	195 °C	16″	11″	11″	135·3	135·3	
1 A.M. ...	195 ,,	17″	12″	1″	12·3	147·6	
2 ,, ...	200 ,,	19″	14″	2″	24·6	172·2	
3 ,, ...	205 ,,	22″	17″	3″	36·9	209·1	
4 ,, ...	205 ,,	24″	19″	2″	24·6	233·7	
5 ,, ..	210 ,,	27″	22″	3″	36·9	270·6	
6 ,, ..	215 ,,	30″	25″	3″	36·9	307·5	
7 ,, .	220 ,,	33″	28″	3″	36·9	344·4	
8 ,, .	224 ,,	36″	31″	3″	36·9	381·3	Measured hot oil and separated water.

Result.	Gallons.	Per cent.
Acid liquor ...	110	8·8
Light Oil ...	130	10·4
Heavy Oil ...	350	28·0
Pitch ...	5,000 lbs.	36·4

PRODUCTION OF SHOOTS BY ANJAN (HARDWICKIA BINATA)

There is a tradition in the Central Provinces that while *anjan* coppices indifferently, it pollards well. Troup remarks that "the tree pollards well even up to a comparatively advanced age and old pollards when repollarded almost invariably produce abundant new shoots, indeed a special feature of the *Hardwickia* forests is the large number of pollard trees, the result of lopping for fodder and manure. On the other hand the tree coppices indifferently". Evidently the term pollarding is here used in a loose sense, shoots from stumps 2 feet high or so being regarded as pollard shoots. While according to the definition adopted by the Yale School of Forestry "a *pollard* is a tree whose stem (or stems) has originated at a height of more than 1'-0" from the ground", shoots from stumps even 1 metre high are considered coppice shoots on the continent. For the purpose of comparing the production of shoots from stumps of different heights and trees of different girths experiments were undertaken in Nimar Division (Central Provinces) in 1911. The following statement gives the details of the trees treated with this object :—

Girth class.	Number of trees cut at height of					Total number.	
	6"	12"	18"	24"	30"		
I ...	20	20	21	18	23	102	12"—18" girth.
II ...	23	23	24	22	22	114	19"—24" ,,
III ...	13	13	14	13	11	64	25"—30" ,,
IV ...	7	5	6	6	7	31	31"—36" ,,
V ...	5	2	2	3	4	16	Over 36" ,,
Grand total ...	...	...	...	...	...	327	

The following statement gives the average heights and girths of the shoots at subsequent measurements:—

No. of trees cut originally.	Height at which cut.	Measurements. 1914. Average height of Dominant erect shoots.	Average girth of Dominant erect shoots.	1919. Average height of Dominant erect shoots.	Average girth of Dominant erect shoots.	1924 Average height of Dominant erect shoots.	Average girth of Dominant erect shoots.	Remarks.
				I Class—Girth 12"—18"				
20	6"	5'—8"	3·6"	14'—8"	8·8"	18'—2"	10·7"	
20	12"	6'—3"	4·6"	16'—1"	10·1"	20'—0"	12·9"	
21	18"	6'—4"	4·5"	14'—7"	9·9"	17'—5"	11·8"	
18	24"	7'—3"	4·9"	14'—10"	9·5"	17'—5"	10·6"	
23	30"	7'—4"	5·5"	14'—9"	9·9"	17'—9"	11·6"	
				II Class—Girth 19"—24"				
23	6"	5'—9"	4·1"	14'—7"	9·9"	20'—0"	12·9"	
23	12"	7'—3"	5·5"	17'—2"	11·9"	22'—6"	15·9"	
24	18"	7'—5"	5·4"	16'—1"	11·2"	21'—9"	14·1"	
22	24"	8'—3"	5·8"	16'—1"	11·8"	19'—9"	13·5"	
22	30"	8'—10"	6·6"	16'—6"	12·1"	20'—5"	14·3"	
				III Class—Girth 25"—30"				
13	6"	5'—8"	4·8"	18'—7"	11·6"	22'—9"	14·4"	
13	12"	7'—11"	6·1"	18'—4"	12·9"	24'—5"	16·3"	
14	18"	7'—9"	5·6"	17'—2"	11·8"	22'—5"	14·4"	
13	24"	8'—7"	6·5"	16'—7"	12·9"	20'—9"	15·5"	
11	30"	8'—7"	6·3"	17'—2"	12·7"	22'—4"	15·1"	
				IV Class—Girth 31"—36"				
7	6"	6'—2"	4·3"	16'—5"	9·1"	22'—4"	13·4"	
5	12"	7'—3"	4·5"	19'—3"	10·2"	24'—9"	14·2"	
6	18"	9'—8"	7·5"	18'—8"	12·0"	24'—4"	15·6"	
6	24"	8'—7"	6·4"	16'—4"	11·4"	22'—0"	16·4"	
7	30"	9'—3"	6·3"	17'—7"	12·5"	21'—4"	14·8"	
				V Class—Girth over 36"				
5	6"	5'—6"	4·8"	19'—0"	13·7"	25'—9"	17·4"	
2	12"	8'—0"	5·0"	20'—0"	13·7"	24'—9"	18·0"	
2	18"	11'—0"	10·0"	21'—0"	17·5"	25'—9"	22·8"	
3	24"	8'—6"	6·5"	16'—9"	13·6"	21'—8"	16·6"	
4	30"	9'—0"	6·5"	16'—0"	11·7"	23'—1"	15·3"	

Heights were measured in feet from the point from which the shoot springs, and girths were measured in inches at a point about 6" up the shoots.

The following conclusions can be drawn from the above figures at this stage :—

(1) Larger girth classes have produced larger shoots.

(2) The heights at which the trees were cut seem to have no constant and definite effect on the development of shoots.

The following statement gives the casualties (percentages) among the various classes cut at different heights.

Girth class.	Height at which cut.				
	6"	12"	18"	24"	30"
I ...	0	5	5	0	0
II ...	13	13	4	0	4
III ...	61	23	14	7	0
IV ..	42	64	33	0	14
V ...	80	50	50	33	25

The above figures indicate that trees of all classes produce shoots best when cut at heights of 2 feet and above. Failures among class V appear high because fewer trees of this class were taken.

Another important conclusion which can be drawn from the above statement is that *anjan* trees cut at 6" above the ground coppice successfully only if up to 24" girth. Over this the number of failures is appalling.

The first conclusion is of great importance, as owing to the hardness of *anjan* timber the tendency is to fell this tree about 24" above the ground which is also quite satisfactory for the production of shoots.

S. A. VAHID, I.F.S.,
Silviculturist, (C. P.)

PARIS GREEN IN MALARIA CONTROL.

With reference to Mr. Pearce's note on Paris Green in the November number of the "Indian Forester," the use of this substance, even in India, can hardly be described as "new". The substance, which is the double salt Copper Aceto-Arsenite, was first reported on by Barbar and Hayne of the United States Public Health Service at the end of 1921. It was tried in America, Palestine, Dutch Guiana and Malaya before it was apparently first used in India by Chalam and Dalal, in 1926, on the Back-Bay Scheme at Bombay. In the following year Nicholls, in a most useful article in the Ceylon Journal of Science (D) makes mention of its use in that Island. I can find no further references in the literature to its use in India, but it has been used for at least a year experimentally on the Raipur-Vizianagram Railway Construction in the Madras Agency Tracts and on suitable areas in the Vizagapatam Harbour Malaria Control and will from now onwards become as regular a weapon of attack as oil spraying in the malaria control areas of the Bengal Nagpur Railway. The new department of Public Health of Mysore State are also preparing to use it largely.

Paris Green, however, is not necessarily elixir of destruction Mr. Pearce seems to suggest. It has its very definite limitations. If dusted over wet vegetation growing around or through the water under treatment much of it sticks to the foliage and fails to reach the water itself. Again, the collection of the large quantities of road-dust required as a diluent presents difficulties. It is towards the end of the rains, and just after, that anti-mosquito work requires to be most intensive, and it is just at this period that dust is hardest to obtain. In the Agency we have been forced to store dust collected in May for use in November, when the construction season re-opens, necessitating the provision of a series of really water-proof-dust stores, adding considerably to the cost.

Again, its action depends entirely on the length of time it keeps afloat. Rain, wind action and swift currents therefore militate against its efficiency. It has so far not been tried against

the swift stream breeder *Anopheles maculatus*, and I am personally rather dubious if it will supersede oil against that species, which one might consider the special enemy of Forest Operations in the Sub-Himalayas, Assam, and certain portions of Madras. A final drawback is that, unlike oil, it will not kill pupae, which do not feed, and its use on a neglected breeding place, or at the opening of a campaign, may allow one generation to emerge. Moreover, it is not a very cheap product. It is not available locally in Calcutta at under Rs. 1/8 per lb.,—though the writer has just obtained a contract for large quantities at a rather lower figure than this. Extensive Italian experiments indicate that it should not be applied at a lesser rate than 10 grams of the pure powder per 100 square metres of water surface, which works out that 1 lb. costing Rs. 1/8/0 only covers 6,222 square yards. In one of the writer's protected camps in the Agency, the ½ mile radius protection circle contains over 4 miles of drainage for weekly treatment!

The complete application out-fit, consisting of road dust sifter, mixing machine and dusting machine, as used in Italy, can be seen at the headquarters of the Mysore Public Health Department. A similar set for the Bengal Nagpur Railway is being manufactured, and will be tested in the Agency. Our work so far has consisted in dusting it by hand down wind only.

In buying this product, it is very necessary to stipulate a specification for Arsenic content—of not less than 50 per cent. insoluble and not more than 1 per cent. soluble. Boyd working in Brazil has reported a complete failure due to the material having been adulterated. A high soluble Arsenic content may sooner or later lead to accidents, though I have not heard of any such. Coolies working with it should be made to wash their hands thoroughly after using it before food,—and it has also been suggested that the same persons should not work with it continuously, owing to the danger of Arsenic accumulating in the system, but be put on other duties, such as oil spraying, in alternate weeks, to give the system a chance to eliminate such accumulation.

The writer will be delighted to keep in touch with any forester proposing to work with Paris Green, in order to exchange experiences.

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Malariologist, Bengal Nagpur Railway,
Garden Reach, Calcutta.

THE SCHIFFERWALD.

The Schifferwald is of special interest to foresters because it is one of the most productive forests in Germany. It contains about 19 square miles (12,500 acres) in area, and is part of the Schwarzwald, and is situated in the Province of Baden on the River Murg, on slopes of hills up to 3000 ft. high. It is owned by the Schiffershaft, who are a private concern, but the State has acquired by purchase 51 per cent. of the shares. In all there are about 20 share-holders, but the majority of shares are owned by three share-holders and by Government : the management consists of a Board of five, who control all business transactions. The three principal share-holders have a permanent seat on this Board, and two other members are elected every three years at a General Meeting. Though Government has 51 per cent. shares, it only has 33 per cent. votes at the General Meeting. Though the Schifferwald is private property, the owners have of their free will placed the forests under State control *i.e.* under the special laws applying to forests owned by public bodies. Accordingly Forest Officers of the State Forest Service are appointed for forestry management, by a further private agreement between the Forest Officer and the owners; the Forest Officer also manages exploitation and sale of timber, building of roads etc. The forests are called Schifferwald because in the 14th. century certain people working on the river termed Schiffer in German, were engaged on the rafting of timber down the Rhine to Holland, and they acquired proprietary rights over some parts of these forests, or hereditary rights to the use of produce from other parts. Of the descendants of these families about 20 remain to-day. In 1814 the forests came, for the first time, under the expert management of a

trained Forest Officer. At that time considerable areas had been denuded of forests and were thickly covered with grass, heather, and weeds, and cattle grazed at large. The Forest Officer's first efforts were concentrated on restricting the grazing of cattle and planting up of the denuded areas.

The present stand consists mainly of conifers, that is spruce, Scots pine, and silver fir, and the main crop is 100 to 150 years old. The lower slopes are stocked with conifers mixed with broad-leaved species, such as beech, hornbeam, etc. which form about 5 per cent of the total crop, and as such trees act beneficially on the soil they are to some extent encouraged. The distribution of various age classes vary in different parts of the forests, a necessary outcome of the irregular, or want of, management, before the appointment of a trained Forest Officer. Some parts are covered with uneven aged crops, others with two age classes, and the higher parts which were left unexploited owing to inaccessibility, are still covered with an irregular crop similar to such as exists in primeval forests.

The average stand is estimated at 120 tons per acre useful timber and the present annual yield of timber is 60,000 cbc. m. —42,000 tons of timber. A rotation of 110 years is aimed at and about 70 per cent. of the crop falls in the age class 80 to 120, 10 per cent. in age class 40 to 80, and only 20 per cent. in the age class 0 to 40. Timber is classified in 6 different classes, according to length and diameter at top end. First class logs are up to 90 ft. long and average about 2½ tons of 50 c. ft. and nearly half of the outturn consists of such timber.

The whole forests are worked over once in two or three years, and the average annual outturn produced is about 3 tons 17 c. ft. per acre.

SYSTEM OF FOREST MANAGEMENT AND OBJECT TO BE ATTAINED.

The system adopted is a system of careful selection. After the usual thinnings all trees which have in any way received injuries, or appear by their crowns not to be of vigorous growth, are removed irrespective of their age, so that only vigorous

growing trees remain in the forests, and each tree has ample room for its development.

Oberforstrath Stephani, who has managed these forests for 25 years, personally marks all the timber for felling, and the present excellent state of the forests is no doubt due to the personal care and time he has devoted to it, so that these forests are to-day considered the best productive in Germany, and are accordingly higher assessed in taxes than any other forests.

SILVICULTURE.

Regeneration is natural or artificial to the extent of 4-5ths and 1-5th respectively. Natural regeneration is encouraged by gradual removal of the stock and opening of the overhead cover. When about 20 years ago natural regeneration became difficult owing to a mat of humus and moss cover, the ground was here and there thoroughly dug up. These operations had, however, not the desired result. Better results with natural regeneration were achieved after more extensive fellings, consequently allowing the sun to act on the soil. According to experience it seems desirable, when natural regeneration is not satisfactory, to have recourse to aeration of the soil, only after the soil has been exposed to the action of the sun for several years.

In some older parts of the forests where no light had got to the soil for many years, natural regeneration did not appear even after the canopy had been opened and the soil hoed over. Then the only possible method was clear felling and replanting. I saw some artificial planting in an adjoining forest. Small holes were dug in the ground, in which the plants which had been raised in seed beds were planted about 6 ft. apart, with triangular spacings, at a cost of about half an anna each plant. It takes natural regeneration 10 to 15 years to establish itself from the time that the canopy is first opened. Spruce and fir comes in from 5 years onwards but silver fir only after 10 years.

EXPLOITATION.

The total capital invested in roads for purposes of exploitation amounts to 1·5 million mark—Rs. 10 lakhs. There are about 90 miles of main roads about 18 ft. wide for hauling traffic

with a stone foundation and broken stone covering. These were built before the war, at about Rs. 7,500 per mile, but now cost more than four times this sum to construct. Besides the main roads there are about 20 miles of *kutcha* roads for dragging timber, which cost about Rs. 2 per metre before the war, and nearly double that now. Besides this there are about 2372 metres of dragging paths costing Re. 1—8 as. per metre, and 8898 metres inspection paths costing about 6 as. per metre. At present about Rs. 40,000 are spent annually on building of roads, and Rs. 46,660 on the upkeep of roads.

Seven men, each on a salary of about Rs. 120 per mensem, are employed on upkeep of roads, and each of them has under him three or four daily labourers on a daily wage of about Rs. 3—8 as.

On exploitation, that is felling, barking, and dragging of timber to the main roads, about 120 wood-cutters are employed, who are paid by piece work at the rate of about Rs. 5 per ton of 50 c.ft. delivered on the main road. The timber is felled down hill, and two or three men, with the help of levers, can thus work down a log of 2½ tons cubic measurement.

The larger logs on the steep inclines are kept in check by means of a wire rope attached by a screw to the end of the log. One man takes a turn round a tree near by, while two or three men working their lever at the lower end set the log in motion. It is surprising to see how easily quite large logs, even up to 3 tons cubic measurement, can thus be transported by a few men. On the average one man fells, clears, and conveys 70 c. ft. of timber daily to the main road, the average distance being about 1000 ft.

Staff.—The whole staff employed in the forests besides those already mentioned under exploitation consists of :—

One superior officer styled Oberforstrath,
Secretary @ 150 Rs. per mensem.
„ Clerk }
Six Foresters } @ 200 Rs. „

The Foresters have been selected from intelligent woodcutters who receive six months' special training, mainly to refresh elementary school knowledge as well as make them acquainted with orest rules and discipline.

When required, a few elderly people and women are employed in planting etc.

FINANCIAL.

The average annual income for three years from 1924-26 was 1·35 million marks—Rs. 900,000 and the expenditure 570,000 marks—Rs. 380,000 with a surplus of Rs. 520,000 but during this period the forests were not worked up to their capacity owing to the poor prices obtainable for timber consequent on large quantities being exported by Czecho-Slovakia. In 1927-28 when the forests were worked to the maximum capacity (42,000 tons excluding bark and branches) the income was 1·92 million marks—Rs. 1·28 million the expenditure 660,000 marks—Rs. 440,000 and the surplus Rs. 840,000 or approximately Rs. 70 per acre.

The income 1924-26 was distributed as follows:—

Timber	... 97·6	per cent.
Shooting, fishing rights etc. ...	... 0·6	,,
Rent and other income ...	... 1·8	,,
Total	... 100	per cent.

EXPENDITURE.

Survey	... 0·3	per cent.
Personal expenses ...	... 8·1	,,
Preparation and sale of produce	... 48·1	,,
Silviculture	... 0·7	,,
Upkeep of roads ...	... 11·9	,,
Other expenses	... 6·8	,,
Total management	... 75·9	per cent.
Capital expenditure on new roads	... 8·7	,,
Taxes	... 15·4	,,
Total	... 100	per cent.

M. C. C. BONINGTON, I.F.S.,

Deputy Conservator of Forests, Andamans.

GEMS FROM THE ESSAYISTS.

"The Sutlaj babbles on the pabbles, triffling like a dancing girl."

"Vasco de Gama did not find the Cape of Good Hope in his bed."

(Wilbur Wright (?)) "took his machine in air at the height of hundred miles and thereby there was less danger of his life."

"The character of a man is known by the cinema he sees. If he sees the films containing love affairs then it shows he is not of good character."

"Cinema teaches us how we can become efficient in stealing and scaling the walls; and snatching glance at other wifes or children."

Once a sluggered man asked an active man, "How to keep fit." He was replied. "Go to the ant though sluggered, she would tell you as to how to keep yourself fit."

"Demosthenes determined to be a great public speaker. He cured his weak voice by crying loudly as he ran steep hills."

(Akbar) "was of a fairly high size, having no beard as he used to make away with it."

"He never feared while riding over a very naughty horse or elephant."

"They (bunias) are an easy prey to sedacious diseases, and we generally find them with big bellies hanging down their chests."

"The cinema can put a very strong impression on the mind and cause it to bend down ultimately."

FOREST PRODUCTS OF JAMMU AND KASHMIR.

COMPILED BY S. N. KAUL, M. F., CONSERVATOR OF FORESTS.

This useful publication might better be named "The Minor Forest Products of Jammu and Kashmir", as very little reference is made to the Major Products, timber and firewood.

In the Preface, the compiler shows that the manual has been prepared with the intention of providing first hand information about the forest products that are useful and have an established market and to suggest others that show similar promise. The manual has been divided, therefore, into two parts. Part I deals with those drugs of commercial importance which occur in the forests of Jammu and Kashmir. These comprise 19 species, under each of which is given the vernacular name, the locality in which it occurs, a description of the plant, the uses to which it is put, and finally figures of annual outturn and the market rate.

The fact that the author, in the majority of cases, has quoted the source from which he has derived the information given concerning the properties and uses of individual species, considerably enhances its value.

In Part II, the compiler has grouped together, by Natural Orders, plants at present used medicinally, but which have not yet a really established market. These have been mentioned in the hope that those interested will take up the investigation of such as are likely to prove beneficial to science or trade.

As noted in the Preface, the information given is by no means complete and it is to be hoped that this useful manual will be enlarged in subsequent editions and that illustrations of the more useful plants will be added, as suggested by the compiler.

At the end of the manual is an index explaining the meaning of the therapeutic terms made use of, and also a general index.

The book is well printed and almost free from errors. Some attention is required, however, in future editions, to the correct use or non-use of a capital as the initial letter in the specific names, as there are occasional mistakes in this connection.

The manual will form a useful book of reference and should prove of special value to dealers in drugs and to all persons interested in the products of the Kashmir forests.

THE FORESTRY QUESTION IN GREAT BRITAIN.

BY PROFESSOR STEBBING. Messrs John Lane, London, price 7s. 6d.

In this book Professor Stebbing deals with the forest policy which should guide the operations of the Forestry Commission in Great Britain. He deals briefly with the history of forests in Britain and the advantages both direct and indirect of forests in this country. His chief criticism of the afforestation policy being pursued is that the claims of the valuable native hardwoods such as the oak and ash have received little attention while the bulk of the afforestation which has been carried out consists of the planting of exotic conifers of speculative value. England is essentially a broad-leaved country ; not only is the forest type a broad-leaved one but so is the type of ground vegetation over all except the heaths of the Bagshot sands and the typical moorlands of the North of England and Wales. The best plantations are on such types as *Mercurialis perennis*, blackberry bracken, in which natural regeneration of conifers is often quite impossible on account of weed competition and it is doubtful whether the best interests

of the country are served by transforming such types into conifers. We consider that more could be done to encourage private forestry by the preparation of plans of management for private owners and even by undertaking the professional management of their forests. The leasing of private property by the Crown is entirely a different matter to advising the owner and assisting him in managing his own property. Many private owners find their forest property unproductive because they are in the hands of the timber merchant and have no opportunity of obtaining professional advice. The book is not of much interest to Indian Foresters except such as are interested in the operations of the Forestry Commission but the points made by Professor Stebbing are well worthy of consideration by those responsible for laying down the policy to be pursued by the Forestry Commission in any future extension of their activities.

THE TIMBERS AND FORESTS PRODUCTS OF QUEENSLAND.

BY E. H. F. SWAIN, CHAIRMAN FORESTRY BOARD, Queensland. (Price, postage paid, paper bound 6/6. cloth 9/6.)

This book deals with the many and varied types of timber trees found in Queensland the State of Australia which by reason of the fact that its vegetation more nearly approaches those types with which we in this country are familiar is of greater interest to Indian Foresters than the rest of the Commonwealth. Queensland like many other tropical or subtropical countries contains a bewildering mixture of hardwoods in the natural bush, some good, others indifferent, and in consequence exactly the same problems have arisen as face us to-day in the case of our mixed forests containing scattered trees of value in a mixed crop of unmarketable timbers. The book deals with 200 wood types under their respective trade names, giving a description of the tree and the methods of identifying it ; its distribution in nature, weight of the timber, quantities and the uses to which it can be applied. The trees of most interest to the Indian Foresters are the Arancarias, Cunninghamii, the Hoop pine and Bidwilli the

Bunya pine. These magnificent trees grow in tropical evergreen forest, their timber is far superior to any imported conifer and commands a higher price on the Australian market than any Eucalypt. They have done remarkably well under cultivation in India. Good specimens exist in Dehra Dun, Saharanpur, Lucknow, Nuwara Eliya in Ceylon and we believe near Darjeeling. These trees should be of considerable value where it is desired to convert evergreen forest of little value into something better.

It should be noted that the most prized furniture wood in Australia is the Indian Toon (*Cedrela Toona* var. *australis*) which has nearly been exterminated in consequence. We cannot help thinking that India does not appreciate sufficiently this beautiful timber. The book also deals with gums and other minor forest products. It contains an excellent index of scientific and commercial names, is well printed and nicely bound, and reflects great credit to the Queensland Forest Service. We offer our congratuations to the Conservator on having produced this excellent book in addition to carrying on his heavy administrative duties.

THE ROOT SYSTEM OF PINE. (PINUS SILVESTRIS.)

A MORPHOLOGICAL INVESTIGATION BY E. LAITAKARI.

Acta Forestalia Fennica 33, Helsinki, 1927.

The knowledge of roots of plants is of great importance not only from a scientific standpoint but also because of its bearing on the practical activities of plant production. The various responses of plants to soil conditions are closely connected with the conditions of their root systems but the subject, especially in the case of trees, has not received the attention it deserves. This may partly be due owing to the manual labour it involves.

In the present investigation the author distinguishes between the horizontal root system which lies close to the surface of the ground and the vertical root system which lies in the deeper-layers of soil. The former has a tendency to develop approximately to the same extent in all directions presenting a star-like

appearance in the beginning but from an early stage, the growth of the side branches which come out from the horizontal roots at a sharp angle, the direction of the prevailing wind, the presence of the nutrients and the moisture in the soil profoundly affect the course of development and disturb the symmetry.

It is generally known that the crown and the root system of a tree are in close co-operation; such a series of co-ordination was proved by Melder from his investigations in Courland (1911). The observations of the present author have, however. shown that the correspondence between the directions of the horizontal root system and the crown is extremely weak and is limited almost exclusively to avoiding a distinct disharmony.

The flattening which generally occurs at the bases of the horizontal roots of pine has received a certain amount of attention and the following observations have been recorded:—

(1) The diameter of the roots at the base in a vertical direction is generally much larger than in a horizontal direction. (2) The roots starting deep are less frequently flattened at the base than those starting closer to the ground surface and the flattening is also more marked in the latter than in the former. (3) The flattening of roots in a vertical direction does not extend very far from the base of the tree. From these obeservations it was concluded that this flattening at the base may serve to provide a strong foothold to the tree to enable it to endure the winds. But as the holding and keeping the tree upright is also done by the tap root and the central vertical root system as a whole, observations were made on trees growing on moorland or in clayey soils in which the vertical root system is poorly developed or sometimes practically absent. These observations confirmed the above conclusion by showing that the horizontal roots are not only more flattened in the case of trees which have no tap root or any other kind of sturdy vertical root system but also that the flattening is greater in such cases.

As regards the vertical or deeproot system it was found that the pine does not always develop a taproot even if the soil conditions present no obstacles. Similar observations have been

recorded by other workers in Finland and Lapland but these are at variance with those of the investigators in Central Europe where the taproot is most common and typically formed.

B. L. G.

EXTRACTS.

WATERLOGGING IN THE PUNJAB.

A feature of the triennium 1924 to 1927 has been the realisation of the threat of extensive waterlogging in the Rechna and Chaj Doabs (the lands lying between the Ravi and Chenab and between the Chenab and Jhelum respectively). During recent years it has become apparent that the threat is very serious on the newer canals (Upper and Lower Chenab and Upper and Lower Jhelum), chiefly owing to the greater intensity of irrigation effected on them. The area actually thrown out of cultivation by the rise of the subsoil water to ground is comparatively small, about 125,000 acres, but in addition there is a considerable area in which cultivation has been stopped by the appearance of salts owing to the rise of the subsoil water. Assuming that the present rate of rise of subsoil water is not checked or retarded, about 500,000 acres will be destroyed in the Rechna Doab by 1931 and about 600,000 acres in the Chaj Doab by 1936. Reducing intensity of irrigation on these canals will enable the engineers to transfer water to the low-lying Nili Bar and Upper and Lower Sutlej non-perennial canals from the Jhelum, Chenab and Ravi supplies and thus to release Sutlej supplies for use in Bhawalpur State in the uplands of Choliston, where it is urgently required in the most arid regions of the Punjab. This would probably prevent failure of the Sutlej Valley Project canals, for which it has been found that the Sutlej supplies are inadequate. It may also permit of the reconsideration of the Bhakra Dam Project without adding to the trouble which the present shortage for the Sutlej Valley Project is expected to bring about when the whole of the construction, still in hand, is completed in another five or six years' time. There is unlimited irrigable commanded desert land on

the left bank of the Sutlej for all the water that can be saved from the canals fed by rivers to the right of the Sutlej by reduction of intensity of irrigation and drainage of waterlogged and threatened areas.

(*Indian Engineering, 19th January, 1929.*)

FOREST REVENUE.

(CONTINUED DROP IN C. P. RECEIPTS).

The report on the forest administration in the Central Provinces and Berar for 1927-28 states that the year adds yet another to the succession of years unfavourable to the revenues of the Forest Department.

The gross income fell by Rs. 2,43,215. The deficit is due to fall in the receipts under the heads "grass and grazing," depression in the local timber market, and to the poor crop of lac combined with low prices.

The Government observed that the sal borer attack is becoming less intense. How far the campaign organised by the department can take credit for this result and how far natural causes are responsible is a matter upon which no decided opinion can be given. If the views of the Chief Conservator that the damage is done chiefly to over-mature and badly developed trees are correct, the report presents the sal borer in a new aspect.

The lesson which it has taught has, however, been a most expensive one. It is hoped that the experience gained will prove sufficient to enable the department to decide what measures should be adopted if it is faced with any recrudescence of this pest in the future.

(*Statesman.*)

BOTANISTS FOR THE EMPIRE.

Dr. A. C. Seward, Master of Downing College, Cambridge, in his presidential address to the Science Masters' Association at Cambridge last night, said that there was a serious dearth of

men of first-rate ability who chose botany as their subject in the second part of the Tripos. There was an increasing number of well-paid, attractive posts in the Dominions and Colonies and at home which could not be filled satisfactorily because of the lack of suitable candidates. While he dared not suggest an addition to an already overburdened curriculum, he often wished that boys could be introduced while still at school to the science of geology.

(*The Times.*)

FORESTRY DELEGATES VISIT CUMBERLAND VALLEY.

The Cumberland Valley, which comprises some 2,000 acres, and forms a part of 115,000 acres on the Upper Yarra Watershed, was visited by the Forestry delegates during their stay in Melbourne. Sit Peter Clutterbuck declared it to be the finest stand of timber he had ever seen.

A specimen acre which was visited showed *Eucalyptus regnans* and *E. gigantea* syn. *delegatensis*, the average age of the former trees being probably well over 100 years. The old trees are over 200 feet high, with 100 feet of clean, straight bole. Part of the oringinal red ash (*E. gigantea* syn. *delegatensis*) stand was destroyed by fire in 1920, but there is a splendid growth of seedlings.

In this acre, the trees numbered 27, their average height was 266 feet, average girth 13·5 feet. Total volume computed to give true cubical content 21,567 cubic feet.

(*The Gum Tree.*)

RAILWAY SLEEPERS.

In an interesting leading article on the subject of Steel Railways Sleepers in Britian in the *Engineer* for 16th November, 1928, it is stated that "as the weight of steel sleepers complete with chairs is little, if anything, greater than that of wooden sleepers in a similar condition, and as the life-save in obviously unsuitable positions is probably two or three times as long, and

as, moreover, the price to-day is very little, if at all, greater than that of creosoted softwood sleepers there would appear to be a very good case for them ".

The article states that the use of steel sleepers was referred to by two Presidents of the Institute of Civil Engineers in their presidential addresses; by Sir John Aspinall in 1918, and by Sir Brodie Henderson recently this year, and concludes as follows:—

"These two quotations from men enjoying the highest reputation in the railway world show, at least, the directions to which thoughts are turning. Sir Brodie was perhaps wrong in ascribing the retention of the wooden sleeper to prejudice. Its use has been supported by good reasons, but once it has been shown that there are even better reasons for using the steel sleeper, it will certainly be adopted."

It has also been recently announced in the press that the Southern Railway in England had placed a trial order for 70,000 steel sleepers. It is evident that if this experiment is successful, as it must be, steel sleepers will be used in Britain more extensively.

In Britain wooden sleepers have to be imported, whereas steel sleepers can be produced easily in the country. In India the position is different as considerable numbers of wooden sleepers are available in the country, the steel sleeper generally being imported. In India, however, there are at present more metal sleepers in the B. G. track than wooden sleepers, and the use of the metal sleepers is on the increase. The chief reason for this is the high price of wooden sleepers. The present price of of the B. G. sal sleeper is Rs. 8, which is approximately the price at which a steel sleeper can be obtained, the latter having at least double the life of the former. If the suppliers of wooden sleepers in India desire to keep the market for them alive and flourishing, and it would be a great pity for it to be otherwise, it is essential that they should make every effort to produce a serviceable sleeper at a lower cost.

The Railways would probably go part of the way to meet the suppliers of wooden sleepers by taking a certain percentage of

half round or slab sleepers, and sleepers with a certain amount of wane, and in fact are already doing so. Such sleepers can be more economically produced than the standard rectangular sawn sleeper, and if creosoted, to preserve the sapwood from decay, would give excellent service.

(*Capital*, *3rd January* 1929.)

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THE EFFECT OF CLIMATE ON THE CONIFERS OF KASHMIR.

The Oecology of Kashmir is yet a sealed book. It is not the aim of the writer to discuss this at any length, for it must require a separate volume to itself; here it is only intended to draw attention to a few glaring contrasts which the forests in the Kashmir Valley bear to the Himalayan forests outside that Valley, for corresponding elevations. The deeper one studies the Kashmir forests, the clearer it becomes that these forests are quite in a class by themselves and that they stand out from the remaining Himalayan forests in more ways than one. The contrasts to which attention will be drawn are so obvious that he who runs may read, yet it does not follow that the Kashmir forests are in any way abnormal; they are just suited to the local oecological conditions and it is difference in the latter which is reflected in the forests themselves.

In the first place, we must clearly define the area covered by the Kashmir Valley, for the word "Kashmir", when loosely applied, covers the *whole* of the Jammu and Kashmir State territories. The Kashmir Valley proper comprises the upper portion of the Jhelum Valley, which is a large plain sixty miles in length by about twenty to thirty miles in width, at an elevation of 5,000′, surrounded by the Great Himalayan Range in the north and north-east, the Pir Panjal in the south and south-west, and by a prominent spur of the Great Himalayan Range in the west which

shoots down from Nanga Parbat, one of the greatest peaks in the world (26,620′), closing the Valley on all sides except at Baramula in the west, where the Jhelum river, whose source is at the eastern end, finds its exit. The forests outside this Valley, therefore, comprise the entire basins of the Indus, Chenab and Ravi rivers, as also the lower parts of the valley of Jhelum.

Before we draw attention to the peculiarities of the Kashmir forests, we must hurriedly examine the "normal" distribution of the State forests, outside that Valley, or for that matter of the British Indian Himalayan forests. For obvious reasons, we cannot refer to the latter in any but the barest outline; we must also ignore minor local modifications and confine ourselves to broad zones of vegetation which are more or less common to the State forests outside that valley. Thus considered, the following five zones of vegetation depending on elevation may be differentiated :—

(*i*) *The Phulai* (*Acacia modesta*) *and Olive* (*Olea cuspidata*) *zone* from 1500′—3000′. This zone has miscellaneous deciduous species common at the foot of the Himalayas, only their number is less than in more eastern parts of the Himalayas.

(*ii*) *The Chir zone* (*Pinus longifolia*) from 3,000′—5,500′. Its usual associates in the upper limit are the *ban* oak, and occasionally *Rhododendron arboreum*, and *Pieris ovalifolia* in the wet parts, and *hiru* (*Quercus Ilex*) chiefly in the drier parts as in Ramban, Kishtwar and Muzaffarabad Divisions of the State.

(*iii*) *The Blue Pine* (*Pinus excelsa*) *zone* from 5,500′—10,000′. This is by far the most important zone both commercially and as regards the acreage covered. It may be sub-divided into the following three sub-zones, each named after the dominant species for that zone, but all inter-penetrated by varying proportions of blue pine which occurs either mixed or pure chiefly on southerly aspects:

(*iiia*) *Deodar* (*Cedrus Deodara*) *zone* from 6,000′—8,500′. It is usually mixed, besides blue pine, with fir and *moru* (*Quercus dilatata*). Commercially, it is the most important coniferous zone in the Himalayas.

(*iiib*) *Fir* (*Abies Pindrow*) *zone* from 8,000′—10,000′ usually encroaching into the deodar forest, and mixed with horse-chestnut, bird-cherry and high-level maples near *nalas* or other wet depressions.

(*iiic*) The *Kharsu* (*Quercus semecarpifolia*) *zone* from 9,000′—10,000′ capping chiefly the cool sheltered valleys, usually the southerly-inclined slopes. In the Ramban Division of the Jammu Forest Circle, this oak affects the upper portions of the Pir Panjal where it occurs gregariously, but disappears more or less completely on northern aspects, and in remote valleys such as Udil and Padar.

(*iv*) *The sub-alpine zone* from 10,000′—12,000′ which caps the crest of the Pir Panjal and is covered with scattered fir or *bhurj* (*Betula utilis*), but is for the most part bare. In this zone are found stray junipers, dwarf willows, and the most important minor forest product *kuth* (*Saussurea Lappa*). The high-level rhododendrons (*Rhododendron campanulatum and Anthopogon*) are also represented. The birch is more common in the drier than in the wet Himalayas.

(*v*) *The alpine zone* from 12,000′ upwards. The tree growth ends with the birch forests at about 12,000′ but herbs, mostly flowering plants of rare beauty, extend up to 14,000′, or to within a short distance of the perpetual snowline, the elevation of which varies according to the aspect.

While there are differences, too obvious, in forest vegetation in different parts of the State, yet the divergences are not fundamental, and it is generally possible to fit in the forests in the above frame which we will consider as the "normal" distribution of forests, depending on elevation. This distribution is common to the major parts of the Jammu Province, the Muzaffarabad Valley of the Kashmir Circle, and to a considerable stretch of the British Indian Himalayan forests. For this reason the above distribution is considered normal.

It is when we enter the Kashmir Valley and compare its forests with the distribution normally found outside, that some unexpected and startling 'anomalies' present themselves for

which there is no obvious explanation at first sight. The outstanding 'anomalies' in the order of their importance are : —

(*i*) *More or less complete absence of deodar on the northern slopes of the Pir Panjal.* This is one of the most important riddles which confronts every Kashmir Forester. Complete absence of deodar for 50—60 miles, even in its own habitat, *i.e.*, from 6,500′ upwards, and in its place mostly fir, with little kail—that is one of the most baffling forest puzzles. Various are the explanations offered : the physical barriers preventing deodar seed to enter into this part of the country, complete hacking of deodar that may have existed at one time, the absence of Hindu population with the corresponding absence of deodar *banis* or forest-temples which are considered to have been artificial nuclei for the introduction of deodar which is considered to be an exotic on this theory, unfavourable climate, there being either excessive rainfall or too little, etc. These and many more are the explanations given, yet it is obvious on re-consideration that none of them is satisfactory. For, in the first place, there are no physical barriers worth mention and there is enough seed in close vicinity which can successfully cover the lower belt of the Pir Panjal, secondly, the hacking theory cannot explain away the above phenomenon as deodar is known to be sufficiently virile; it regenerates itself quickly where there are gaps in the canopy and it is inconceivable that the process of regeneration and recuperation may have been totally eclipsed by that of wholesale felling. Even in the worst days of forest protection in Kashmir, the deodar was considered to be a valuable species and no one could remove deodar with full impunity, not to speak of wholesale slaughter. The absence of Hindu population cannot explain it any more than the above theories, for there have been Hindus in this Ilaqa before the Mughal Rulers converted them. Nor does the sacred deodar-groves theory carry us any nearer the solution, for there is deodar in the Lolab valley where there are very few such groves. The climate does not explain it either for the rainfall is just what it should be. The Editor of the *Indian Forester* summed up his conclusions about the ideal climatic conditions for deodar

in the following words in a recent issue of the *Indian Forester* :—" What deodar really wants is a climate with rainfall 35″-50″ of which a considerable amount falls in the winter preferably in the form of snow. " The rain gauge maintained at Kulgam at the foot of the Pir Panjal in the said zone records a fall of just 35″ per annum, over 50 per cent. of which falls in winter chiefly as snow; the rainfall higher up in the Pir Panjal varies between the above-mentioned limits *i.e.* 35″ to 50″. There cannot, therefore, be anything wrong with the climate. The soil is deep clayey loam for which the *Krewas* in Kashmir are famous.

Thus, the Pir Panjal sits Sphinx-like propounding a forest riddle of the first magnitude defying solution. This, however, is not all; there are other conundrums just as embarrasing.

(*ii*) *Complete absence of chir pine from Kashmir.*—The slopes around the Dal and the Wular lakes which one might expect to be wooded with chir are bare, and even in protected parts of the country, the chir is conspicuous only by its absence. This cannot be due wholly to elevation for on southern slopes, chir is known to extend to even 7,500′ e.g. Chakrata, Bashahr, Kulu, Garhwal etc. (*vide* Troup's monograph on chir). In the Jammu Province, chir extends to the very foot of the Pir Panjal on the southern slopes e.g. Digdaul chir, but in Kashmir, not a tree of chir is found!

(*iii*) *Chir* is by no means the only tree which finds the doors of the Sacred Valley shut hard to it, the same is true of oaks (all species), laurels, the low-level rhododendron, of *Pieris*, *Cornus* and *Carpinus*, and many species of *Euonymus*. The alder (*Alnus nitida*) which is so common in Ramban, Buniyar and Udil as to deserve the name of the characteristic *nala* tree is also absent. The only important broad-leaved trees that are found are the birdcherry, the horse-chestnut, birch, the high-level maples, the walnut, the elm and the hazel, but even these are confined for the most part to *nalas*, wet depressions or the uppermost limits of coniferous forest so that the forest remains remarkably pure.

(*iv*) As against above, it is generally kail and fir that are dominant, the former on southern, the latter on northern aspects descending sometime to even 6,500′—both at the expense of deodar—

the most valuable species. The usual associate of kail, there ore, in Kashmir is not so much deodar as fir. Again, both kail and fir are unmixed with spruce which is such an important feature of the British Indian Himalayas. Pure spruce forests in Kashmir are unknown, and even in mixtures its percentage hardly exceeds 3·5 per cent. and is generally much less.

(*v*) From the above follows another physiognomic feature of the Kashmir Valley *i.e.* the remarkable purity of the coniferous forest of deodar, kail and fir, where found; this "purity" must, however, be judged comparatively.

Not only is the upper canopy devoid of mixtures but the lower canopy is also devoid of such weeds and obnoxoius bushy undergrowth as *Strobilanthes*, *Daphne* sp. *Arundinarias*, *Sarcococca pruniformis*, etc.

The climbers also are few or non-existent.

This also conduces to the comparative ease of their reproduction except in such places which have been trampled hard with over-grazing which is excessive in populous Kashmir, and in places where *pohu* (*Parrotia jacquemontiana*) forms a dense cover, for *pohu* is a dangerous competitor of deodar in wet places.

On the whole, however, the purity and the comparative ease of reproduction of the Kashmir conifers, including fir, are features which strike any visitor to these forests.

Anomalies such as these cannot be explained by silviculture so-called, for silviculture takes the crops as they are and improves them, but is not directly concerned with the fundamental problems of distribution although it very nearly approaches them. On the other hand, it is the primary function of Oecology to explain why each species has its own habit and habitat, and why the same vary in different places. *True* silviculture is not divorced from Oecology, on the contrary, it embraces Oecology, and many other cognate sciences, and yet transcends the same. We must, therefore, turn to Oecology and see whether the latter explains what ordinary silviculture does not.

The anomalies, in question, are not only of academic interest but of fundamental practical import ; they have immediate forest value. No Forester who has seen these forests has been able to suppress such tumultous questions as the following, until the cold breeze of inertia chilled the youthful springs of their forest activity. They have oftentimes asked themselves : Can't we successfully transform the valueless fir forests of the Pir Panjal by deodar forests of infinitely more value ? If we cannot do so wholly, can't we do so partially ? Is it not possible and desirable to afforest the bare slopes around the Dal and Wular with chir-pine ? Can't we grow oaks and thereby solve the perennial problem of the shortage of hardwood fuel in Kashmir ? If we could do so, we would be doing a great service to the inhabitants of the Valley who prefer hardwood to softwood fuel obtained from fir or willows ! Questions such as these crop up again and again, and those who are eager enough have tried some experiments also in this direction, but with disappointing results.

Whatever, therefore, the prospects of successfull introduction of the missing species, it is desirable at least to study the problem a little more carefully if only to prevent waste of money on unsuccessful experiments.

In the second part, an attempt, however imperfect, will be made to explain the aforesaid anomalies.

II. Referring to the utility of œcology, Mr. Hole said " for Foresters at all events œcology is probably the department of botany of most interest and of greatest practical importance. In œcological study a Forester can utilise all the knowledge he possesses of Morphology, Anatomy, Systematic Botany, Physiology and Pathology to the greatest advantage in the solution of problems of practical importance." Silviculture itself is but amplified œcology directed towards the production of forest crops of the greatest commercial value. Let us, therefore, study the above silvicultural problems in the light of œcology.

To begin with the important question of the absence of deodar on the northern slopes of the Pir Panjal, we have seen that rainfall and depth of forest soil do not explain this anomaly.

But in œcology there are always more factors than one, and any one of these may play a *dominant* role——a factor which may be pronounced only in this part of the country as against other coniferous deodar forests on corresponding elevation. When we study these forests, we find that there is actually one such factor which is characteristic only of these Himalayas, and which is not so well-pronounced elsewhere, and that is the 'abnormal' topography of the Pir Panjal. This feature lies in the exceptionally gentle gradient of the foot of the Pir Panjal, which has therefore been compared to the 'writing-desk.' The average gradient will be judged from the fact that there is a rise of 5 degrees only in a distance of 20 miles. This corresponds to a rise of about 8,500′ from 7,000′ at the foot of hills to 15,567′, the height of the Sunset peak, the highest peak of the Pir Panjal, in the aforesaid distance, which works out to a gradient of 1 in 12; actually however, it is as low as 1 in 25 or 30 in the normal deodar zone——a gradient fit enough for a motor drive through the forests!

This exceptionally low gradient reacts adversely on deodar growth in more ways than one. In the first place, a northern slope is always much cooler than a corresponding southern slope. Secondly, this easy gradient lets snow lie on the ground for much longer time than it would normally remain, for the snow at the time of melting is not as much helped by gravity as it is in the case of steep slopes. The conjoint result of these causes is that both snow and the water lie on the forest floor for many months more than in other parts of the Himalayas, producing a soil far too wet, and far too badly aerated than is necessary for deodar. Deodar, as is well known, is a xerophytic species, and is very sensitive to drainage, but the configuration of the Pir Panjal tends to produce soil conditions which are quite the reverse of its normal requirements. It is this more than anything else, which is responsible for the absence of deodar in the said area. That this is so is further proved by the fact that where the gradients are steep enough——steeper than normally obtainable at the foot of the Pir Panjal—the deodar does make its appearance although it exists sporadically. Thus, for instance, in Khag and Yarwan where the slopes are very steep to precipitous—the few

places where there are really steep slopes in the deodar zone—deodar is found, even though it is missing for many miles at a stretch in the intervening flat area. It follows, therefore, that the edaphic factor which is playing a dominant role in this case is the exceptionally gentle slope with consequent bad drainage, defective soil aeration, and generally the production of conditions far too mesophytic for a xerophytic species like deodar.

The selfsame conditions which produce soil unfit for deodar are just suited for fir, as fir requires comparatively more soil moisture, more snowfall, more humidity, and more prolonged winter than deodar. According to Warming, silver-fir and spruce require "as much moisture as broad-leaved trees" (P. 564, 1909 edition); the gentle slope of the Pir Panjal provides just the optimum conditions for the growth of silver fir. While, therefore, deodar and fir can exist on comparativaly steep slopes, yet on gentle slopes which are as moist as *nalas* and other wet depressions, the silver fir alone has the upper hand displacing deodar, the extreme limit being reached in the Pir Panjal forests. The absence of deodar, therefore, in this area is one prominent illustration of Clements' general hypothesis *viz.*, "it is impossible for the same habitat to produce both hydrophytes and xerophytes."

If, therefore, practical forestry wants to substitute deodar in place of fir, it must first choose *steep* slopes, secondly it must take in hand those areas from which snow melts comparatively early *e.g.*, southerly slopes. In other words, it would be much better to tackle first steep kail-covered areas rather than introduce deodar in flat areas fit only for fir in this part of the Himalaya.

The dominance of fir in this zone is accentuated by other contributory factors which are discussed hereafter, but it is the gentle conformation of the hills which plays the pre-dominant part in this case.

The absence of chir, oaks and other broad-leaved species mentioned before is, no doubt, attributable to the peculiar climatic conditions *i.e.*, deficient monsoon rainfall, heavy snowfall and increased winter rain. This is in sharp contrast to the conditions

prevailing in British India or in Jammu Province as will be evident from the following table:—

Rainfall data comparing Kashmir Valley with British Indian part of the Himalaya.

Station.	Rainfall from June to September	Rainfall October to May.	Whole year.
Handwara (Kashmir)	9·56″	36·95	46·51″
Kulgam, Pir Panjal (Kashmir)	8·94	26·14	35·08
Kulu	26·38	17·27	43·65
Chakrata	53·15	19·63	72·78
Ramban (Jammu Province)	14·77	31·49	46·26

From this it will be seen that in the Kashmir Valley, there is very little monsoon as compared with British India. The dearth of monsoon reacts adversely on the growth of chir, oaks and other broad-leaved species mentioned above. As to how it does so cannot be definitely stated, but there is little doubt that it has some connection with seed germination, although it may have other effects also. In the case of *moru* and *kharsu* oaks, for instance, it is known that they ripen during the monsoon rains and germinate immediately if there is sufficient moisture on the ground, and that the failure of monsoons reacts unfavourably on germination. As in Kashmir there is very little monsoon rainfall, hence the failure of the above species is quite understandable. What is true of the above oaks, is also true of chir germination, in a large measure, and this may explain its absence in the Kashmir Valley. As regards other ways in which low summer rain reacts on other species, in question, there is vast œcological ground open for research and exact delineation. This much, however, is clear that in this case, it is not the soil which plays dominant role but the climate.

The dominance of fir in other parts of the Kashmir Valley, besides Pir Panjal, is due chiefly to the heavy winter snowfall as is

evident from the above table. But this exceptional feature peculiar to the Kashmir Valley is strengthened by another, namely increased humidity, which is due to many miles of lake water and paddy cultivation all over the Valley. The following table compares the humidity of the Kashmir valley with other Northern Indian Hill Stations (figures taken from Monthly Rainfall of India) :—

Humidity data etc.

Station.	Mean, Maximum Temperature.	Mean, Minimum Temperature	Rainfall	Humidity.
Srinagar (5204′)	68·0	45·4	17·63	71
Murree	63·5	53·1	38·95	59
Simla	60·1	49·9	80·88	56

From the above table it will be seen that the humidity of Kashmir is exceptionally high, of Gulmarg a typical fir area, it is higher still being 77 as against 71. As compared with Srinagar (5204′), Batote in the Jammu Province which has much the same elevation has a mean humidity of only 60. The effect of this increased humidity is to reduce transpiration and thereby make conditions much more suited for fir than for deodar. This is why deodar in the Jammu Province, wherever found, is much more healthy than in the Kashmir Valley proper. Perhaps, the most ideal conditions for optimum growth of deodar are found in Udil and Bhadarwah Valleys of the Jammu Province; the Lolab Valley, in Kashmir, though producing purer deodar than the aforesaid valleys is already suffering from increased humidity as is evident from its infection with *Trametes pini*—the only place in India perhaps, where the deodar is so affected. It follows therefore, that the increased humidity of the Kashmir Valley is also an important factor helping the comparative dominance of fir in this Valley, at the expense of deodar.

As regards the parallel phenomenon of the dominance of blue ine, the explanation must be sought for not in the direction

of winter fall of rain, but the summer or monsoon fall. For, a comparison of the distribution of bluepine in Jammu and Kashmir, as also of the outer valleys with the inner drier valleys shows that the greater the dominance of the bluepine, the *poorer* the monsoon rain. For instance, the bluepine is much more dominant in the side valleys of the Lolab which are drier than in the mother valley itself which receives comparatively more rain and therefore, has more deodar than bluepine. In the Jammu Province, there is more deodar than bluepine in Bhadarwah as it receives the bulk of monsoon rain, and as the intensity of monsoon falls off towards Kuntwara, Udil and Padar, the bluepine becomes much more evident. Compared with British India, the Kashmir Valley receives much less monsoon rain than the outer ranges of the British Indian Himalaya. If, therefore, we were to graphically represent the distribution of bluepine on the Himalayan Range, it will be expressed by a horizontal—V, which has its apex towards British India, its mouth towards Kashmir :—

KASHMIR > BRITISH INDIAN HIMALAYA.

(*Bluepine distribution in India.*)

The following table compares the typical bluepine stations, namely Handwara in Kashmir and Ramban in Jammu Province, with Kangra-Dhauladhar, where, according to Parker's Flora, there is no bluepine whatsoever :—

Station.	Rainfall in monsoon June to September.	Abundance of bluepine.
Handwara (Kashmir) ...	9·56″	Good.
Ramban (Jammu) ...	14·77″	Good.
Kangra-Dhauladhar ...	34·72	*Nil.*

The spruce, though apparently related to bluepine, is quite its reverse in moisture requirements, particularly monsoon rain : the

greater the monsoon rain the more it flourishes. The spruce—V, therefore, has its apex in Kashmir, its mouth towards British India :—

KASHMIR < BRITISH HIMALAYA.

(*Spruce distribution in India.*)

We will not labour this point any further beyond stating that there is immense field for research in the direction of interpolating the data between Kashmir at one end, and Darjeeling on the other. Enough, however, has been said to indicate that the dominance of kail and fir in the Kashmir Valley at the expense of deodar, in many cases, is a direct result of the climatic conditions.

From all that we have said above, the purity of Kashmir forests, as compared with forests on corresponding elevations in British India, as also the Jammu Province, follows as a matter of course and it is this feature which strikes any Forester on his first visit to the Kashmir Valley.

The purity of any forest, of course, simplifies the problem of reproduction. In the case of the fir forests of the Pir Panjal, the exceptional ease with which the silver fir reproduces itself has already been described in the pages of the *Indian Forester* and will not be referred any more here. We could wish that the regeneration of deodar and kail were just as simple—and the climate makes conditions suitable for this consummation—but the problem of reproduction is not so simple as it may appear. It depends on many factors, not the least important of which is grazing, which, as already mentioned, is far too excessive in the over-populated Kashmir. Further, there is the local problem of *pohu* undergrowth interfering with deodar regeneration. In spite of these disturbing factors, the regeneration of many of the Kashmir forests is all that might be expected, and where the conditions are unfavourable, intensive forestry can improve matters. The problem of regeneration, however, does not concern this brief paper which deals more with the glaring contrasts of the Kashmir forests with the forests outside than with anything else.

Conclusion—This brief sketch, however imperfect, shows that the Kashmir Valley provides almost ideal conditions for the *comparative* study of the hill-flora of the Northern India, which is the same thing as their œcology. The study of œcology is always obscured by many factors which interact, supplementing themselves wherever possible, but very often neutralising themselves in varying degree. If we study these factors in one and the same place, it will never be possible to unravel the silken skein of œcology, nor again will it be possible for the Foresters—the helpers of Nature—to assess the comparative *local* value of any silvicultural factor. In the Kashmir Valley, the aforesaid skein unties itself because the complicating influence of the monsoon—one of the most important, if not the most important factor in Indian Silviculture—is removed from the sphere of action, or paralyzed to a large extent. It is this which makes the Kashmir forests stand out from the outer Himalyan forests—a study in themselves, unencumbered with monsoonic complications.

But the study of Kashmir forests has not only local importance, it has all-India importance, for it enables, for the first time, the correct assessment of different silvicultural factors which in India are tragically transmuted, being seen through the coloured spectacle of the Indian monsoon. If, therefore, we are to correctly evaluate the monsoon-factor, we must study first the forest where it does not exist, and then study its gradual inter-penetration in India from Kashmir outwards.. And what is true of the hill forests is truer still of the plain forests including teak, sal and the evergreen *dipterocarps*. This means *comparative* study of silviculture which is quite in its infancy in India. And comparative silviculture is œcology, more accurately applied œcology. It is only by standing on the vantage ground of œcology that Indian Forestry can be viewed in its correct perspective, and thereby made more real and effective. True silviculture, it may be repeated, embraces œcology and yet transcends the same.

This brief paper is, therefore, a plea for a more rapid *rapprochement* between silviculture so-called and œcology than has ever been possible in the past—a loving wedlock between the male and female sides of Forestry. This is a task which the

Central Silviculturist alone can successfully undertake and consummate. The writer will, therefore, conclude this paper and rest content with the fact that he has drawn the attention of the authorities not only to the importance of œcology in the study of Kashmir forests, but what is of infinitely more importance, *i.e.*, the œcological-*cum*-silvicultural survey of Indian forests.

DODA.
14th December 1928.

SHER SINGH,
Jammu & Kashmir
Forest Service.

THIRD BRITISH EMPIRE FORESTRY CONFERENCE (AUSTRALIA & NEW ZEALAND) 1928.

(Continued from pp. 125—138, March Number.)

REPORT OF THE COMMITTEE ON FORESTRY TECHNIQUE.

The importance of forest management is generally recognized by foresters. By forest management is meant the orderly conduct of fellings, tending operations and works of regeneration with the object of fulfilling the purpose for which the forest is managed.

WORKING PLANS.

2. With the adoption of the policy of the sustained yield, which is the foundation of sound management, forest working plans for the regulation of this yield become imperative. Before such a plan can be prepared, it is necessary to make a survey of the area showing boundaries, roads, rivers and the general topography of the country. This may be done by the ordinary ground methods or by aerial photography or mapping, a method which has been largely developed in Canada and which has been used with success in Burma and Bengal. Except where the simplest provisional management only is necessary, a stocktaking is required. Much of this work has been done from the air with check operations from the ground.

3. No plan of management can be called effective unless it includes—

(*a*) A statement of the objects for which the forest is managed.

(*b*) A calculation and regulation of the yield.

(*c*) The building up of a normal series of age classes.

(*d*) The protection and improvement of the forest estate.

(*e*) The exploitation and disposal of the produce.

(*f*) Provision for control.

4. It may be taken as an axiom of forestry that if a forest is worth working at all it is worth bringing under regulated management. The papers which have been prepared for the conference and the speeches which have been made in debate show how the preparation of working plans can be developed and how a simple regulation by area fulfils the requirements of management until more detailed plans become necessary. In many parts of the Empire the position as regards working plans is unsatisfactory, and efforts should now be made to remedy this state of affairs. It has been accepted in Burma and in a few other places that no exploitation may be made except under a plan of management and the committee would like to see this provision extended to other parts of the Empire.

5. In several provinces of the Indian Empire a special organization for the preparation and control of working plans has already been set up with beneficial results, both in the increase of areas brought under working plans and in the quality of the revisions of plans prepared in the past. A working plan must be workable, and its details must be frequently revised, although the original framework may continue over a long series of years.

6. Without working plans the future of the forest and of the industries depending on it and even the agriculture of the neighbourhood have no security. Without a proper provision for supplies in perpetuity, the position of the large capital invested in pulp and paper mills, in saw-mills and other wood industries is insecure. Already in certain countries the wasteful exploitation of the forest has resulted even in the disappearance of whole towns and the ruin of agriculture following the closing of the mills on which the community depended for a livelihood. On the other hand, the organized management of forests ensures a definite population in tracts now uninhabitated.

7. The committee has been impressed with the fact that these essentials have been grasped in certain States of the Commonwealth of Australia, where a commencement has been made in bringing the valuable forests of the State under regulated management and in preparing planting plans for softwoods with a view to their economical exploitation at maturity; but they point out that a great deal is still necessary before the position in Australia can be considered satisfactory.

SILVICULTURAL BASIS.

8. Forest management is intimately associated with and directed by silviculture, by which is understood the knowledge of the growth and development of forest trees growing together as forest crops; their requirements as regards soils, light, moisture and temperature, and the various factors which regulate climate, the manner in which they seed and the conditions necessary for their regeneration, whether by natural or artificial means. On such knowledge rests all other branches of forestry. Silviculture is, therefore the foundation of all true forestry, and without a knowledge of silviculture no progress in scientific forestry is possible.

9. The committee, while appreciating the advantages to be derived from afforestation, wishes to emphasize the fact that forestry does not consist merely in the planting of some exotic species of tree, that the care and perpetuation of the native forest is often more important than afforestation.

10. A thorough knowledge of silviculture can be acquired only by practice, following a sound forest education, and consequently a forester can be expected to have a detailed silvicultural knowledge only of those species of trees with which he is more intimately concerned. Each country, therefore, must acquire for itself the knowledge and practice necessary so that management may be based on sure foundations. The papers presented to this Conference give a sufficient indication of the vast scope of this subject in Empire forestry which is concerned with every type of vegetation known on the earth. The forests of Canada, the tropical rain forests of equatorial Africa, and the eucalpyts of Australia have all received some consideration at

the Conference. To enter into details of the silviculture of various trees or forest types is a task of immense magnitude which we do not propose to pursue.

SILVICULTURAL RESEARCH.

11. The committee, while acknowledging the work already done, has been impressed with the great field which still lies open to the student of silviculture. Only the fringe of that knowledge necessary to complete success has been gained. The field for research in silviculture, whether by the individual or by special research workers, is almost unlimited. The steps which have been taken in some countries to promote such study indicate that the increasing importance of this subject is being realised.

12. In short, the technique of silviculture consists in the best methods of regeneration and tending of forest crops under the various conditions of soil and climate, with a view to the most profitable production of timber or other forest produce. Until the knowledge necessary is available, no progress can be expected, and the sooner such knowledge can be obtained, the greater the benefits which will ensue to forestry in the Empire.

(Signed)

C. G. TREVOR (*Chairman.*)
H. R. BLANFORD.
S. L. KESSELL.
S. H. HOWARD.
H. A. PRITCHARD.
H. M. GARDNER.
J. BUNNY.
D. K. S. GRANT.
E. J. ZAVITZ.
R. S. TROUP.

REPORT OF THE COMMITTEE ON THE EMPIRE FORESTRY BUREAU.

Terms of Reference.

The following were the terms of reference :—

"The Conference having expressed the unanimous opinion that, in view of the various organizations which have arisen since

it was first proposed to set up a bureau, the establishment of a separate bureau is unnecessary, the Committee is desired to consider and report on—

I—The work to be done;

II—The procedure by which the work should be done:

III—The cost of the proposed procedure and the basis of contribution by units of the Empire."

The Committee begs to report as follows :—

NATURE OF WORK TO BE UNDERTAKEN.

I. *The work required to be done.*—After hearing the views of delegates representing the Dominions, India, the Colonies and non-self-governing dependencies, we find there is a general desire that the following work should be undertaken :—

(*a*) The preparation and publication for circulation to the forest departments of the various units of the Empire of abstracts of current forestry literature and the publication of reviews by recognised experts on the more important works. The supply of copies, extracts or translations of original articles when required on payment.

(*b*) The supplying of information as to the investigation being carried out by research and other authorities.

(*c*) The provision of facilities for dealing with inquiries relating to—

(i) silviculture and management, or to any subject connected with the living tree;

(ii) timber;

(iii) minor forest products.

(*d*) The according of assistance in the marketing of forest produce and the preparation of statistics bearing on the same.

HOW WORK SHOULD BE UNDERTAKEN.

II. *The procedure by which the work should be done.*—We are of opinion the work referred to under I *(a)* and I *(c)* (i) should

be undertaken by the Imperial Forestry Institute at Oxford, where special facilities exist for the purpose. At that institution there is already an excellent forest library and a system of reference literature which makes it possible quickly to find papers written on any subject. There are also means for securing translations of forestry articles written in almost any language. Moreover, the institute is equipped with a staff of specialists. In short, the framework of the machinery needed for this particular function already exists at Oxford and only needs filling in. In addition to disposing of inquiries relating to silviculture and management, the institute should deal with those bearing on forest policy, education, economics, engineering, botany, zoology, and pathology; also the structural examination and identification of wood.

It is to be understood that forest officers in different parts of the Empire would not address inquiries to the Institute should there be local institutions equipped to dispose of the same.

I (*c*) (ii).—We consider that all information needed under this head and comprising the physics, seasoning, preservation, testing, pathology and utilization of timber could be provided by the Forest Products Research Laboratory at Princes Risborough, though countries with their own forest products laboratories would naturally have inquiries on these subjects addressed to these institutions direct. If any information involving special study is desired by any unit of the Empire, it is considered such unit should be prepared to find any funds required.

I (*c*) (iii).—In regard to minor products your Committee considers that requests for information in connexion with them should be referred to the Department of Scientific and Industrial Research, of which the Forest Products Laboratory at Princes Risborough is a section. It is, at the same time, recognized that that department is not yet fully equipped to deal with all inquiries on this subject that might he addressed to it, and your Committee, therefore, thinks that for the present, while inquiries should be addressed to it, that department should pass to the Imperial Institute questions of comparative tests, statistics, marketing and other matters with which it is not in a position to deal.

MARKETING OF FOREST PRODUCE AND STATISTICS BEARING ON SAME.

I (*d*) The according of assistance in the marketing of timber and the preparation of statistics bearing on the same.—In so far as this sub-head is concerned, your Committee would recommend that the Empire Marketing Board should be approached to set up an Empire Timber Office in the City of London, and be asked to invite all parts of the Empire to allow their timber representatives to work there and to provide office room for a liaison officer of the utilization section of the Forest Products Research Laboratories in order that technical information may be available on the spot.

PUBLICATION OF RESEARCH PROGRAMMES AND OTHER INFORMATION.

In regard to the work which is referred to under head I (*b*), your Committee feels that the requirement would be met by the publication annually in the *Empire Forestry Journal* of a *résume* of the research programmes of the different units of the Empire. The chairman of the Empire Forestry Association, who has been approached on this subject, has intimated that the association would gladly undertake this work, and further, that it would not only publish the reviews mentioned in I (*a*), but would be prepared to insert in all issues of the journal the names of the persons or institutions to be addressed by any one desiring information on any particular subject.

Further, should there be any doubt as to the authority who should be approached, the secretary of the Association, if addressed, would undertake to direct inquiries from any applicant to the proper quarter. The Director of the Imperial Institute as also intimated that he would supplement the publicity work of the Empire Forestry Association as far as may be desired.

IMPERIAL FORESTRY BUREAU.

3. *The cost of the proposed procedure and the basis of contribution by units of the Empire.*—In making its recommendations for the allocation of the work detailed in 1, your committee has constantly kept before it the evident desire of the conference to avoid replacing the somewhat expensive Bureau originally

suggested by an organisation other than one of a most economical character. Your Committee feels that the proposals made in 2 give adequate effect to this desire.

COST OF ORGANIZATION.

After consulting Major Oliphant, of the Forest Products Research Laboratory, Princes Risborough, the Director of the Imperial Institute and the Chairman of the Empire Forestry Association, your Committee has ascertained that the institutions are each prepared to do the work proposed for the bodies with which they are associated without making any request for additional funds.

The position in regard to the provision of funds by the Empire Marketing Board for the setting up of an office in the City of London, your Committee feels, cannot be cleared up at present, as no representative of that body is available for consultation and the matter must perforce stand over till the Standing Committee of the Conference reaches London.

There thus remains only the question of the provision of funds to enable the Imperial Forestry Institute at Oxford to carry out the further functions suggested for it.

Your committee has been provided by Professor Troup with an estimate of the additional funds he considers necessary, and these amount to £2,500. Your Committee, after examining the estimate carefully, considers it reasonable and recommends its acceptance by the Conference.

BASIS OF CONTRIBUTION BY UNITS OF EMPIRE.

In regard to the basis of contribution, your Committee has been gratified to learn that the representatives of the Dominions, India, the Colonies and non-self-governing Dependencies are prepared to recommend financial support of the proposed organisation to their governments, and suggests that contributions might be distributed in proportion to the strength and importance of the forest services and interests of the different units of the Empire.

Initiation of Scheme to be Entrusted to Standing Committee.

In the opinion of your Committee, the initiation of this organisation should be entrusted to the Standing Committee on Empire Forestry, and as the funds subscribed are to be allotted to one institution only, it is not thought necessary to arrange for any co-ordinating committee or authority,

Method of Accounting for Funds.

The funds collected would be accounted for by the governing body of the institute strengthened, if need be, by representatives of the subscribing authorities, and in the same manner as prevails in respect of the contributions now being made to the institute by the existing subscribers.

Organization to be on Trial for five Years.

Your committee would like it to be understood that they consider the organisation now proposed should be given a thorough trial during the next five years. Experience will show what modification, if any, it may require, and the whole matter could be reviewed on the occasion of the next conference.

(Signed)

C. E. Legat, (*Chairman*)
J. Bunny,
P. Clutterbuck,
E. H. Finlayson,
R. D. Furse,
W. Furse,
A. Hansson,
C. E. Lane-Poole,
R. D. Richmond.

Report of Committee appointed to consider the question of Forest Products and Empire trade therein :—

The Committee begs to report as follows :—

The subject naturally divides into two headings—

A. Forest products research.

B. Development of trade in forest products of Empire.

A. Forest Products Research

(1) Co-ordination of work.

Your Committee affirms it is the duty of each forest products laboratory within the Empire to keep in touch with each other laboratory of like nature with a view to effect an exchange of publications and information.

Your Committee is of the opinion that forest products laboratories should circulate annual or periodic programmes of work for information, and, if desired, comment. Where institutions are engaged or are about to engage on similar investigations they could with advantage exchange "draft projects," and all forest products laboratories should exchange their final projects with each other for information and record.

In view of the great value of personal contact between "specialist officers," and of inspection by them of work in progress the Conference recommends to all Governments that, wherever possible, facilities for such visits should be provided.

The fullest co-operation should exist between the various laboratories, and each should be prepared to undertake "suitability tests" on behalf of any other, if so requested.

By "suitability tests" is meant investigations to determine the suitability of any forest product for use in the particular country in which the laboratory is situated, or for use under a given set of conditions.

(2) Work for parts of Empire not possessed of complete laboratories.

(*a*) Major Products.

Your Committee endorses section 85-86-87 of Imperial Economic Committee's report number 10. They further recommend that where on account of geographic or other reasons the work can be better undertaken by any other laboratory within the Empire such devolution should be arranged by Princes Risborough with the particular laboratory concerned.

Your Committee, however, cannot entirely endorse paragraphs 89 and 90 in that report, believing that the tests carried at Princes

Risborough on behalf of colonies should not be confined to timbers the sale of which is to be pressed in the United Kingdom. While priority may well be accorded to such timbers, the quality of timbers for local use, or for markets in other parts of the Empire is equally important. Similarly, comparative tests of timbers as to their marketable possibilities if and when they can be produced in marketable quantities, may be of the greatest importance to all parts of the Empire.

(b) Minor Forest Products.

Your Committee recommends that the problems involving research in connexion with minor forest products should all be referred to the Department of Scientific and Industrial Research, with a view to having all forest products research done at or through Princes Risborough when that laboratory is fully equipped to undertake it, and further that early steps should be taken to put Princes Risborough in a position to do this work.

If research work either in major or minor forest products is desired by any unit of the Empire it is considered that such unit should be prepared to pay for the work done on a cost basis.

B. Development of Trade in the Forest Products of the Empire.

(1) Major Products.

The Committee has considered report No. 10 of Imperial Economic Committee on Timbers and the discussions of the Conference thereon and is in general agreement with the findings therein. Your Committee appreciates the work of the Advisory Timber Committee at the Imperial Institute which for twelve years past has been engaged in testing and assisting in the marketing of the Empire timbers, and recognises the necessity for the co-operation of such a committee for such a purpose. It further is aware that Princes Risborough has a utilisation section though its work is not confined to Empire timbers. It strongly recommends that the Empire Marketing Board should be approached with a view to the setting up of an office in the City of London where all information necessary to marketing of Empire timbers would be obtainable. The officer in charge

should work in the closest touch with the Forest Products Laboratories, and with any timber trade representatives appointed by the Dominions, India, the Colonies or other parts of the Empire. This office could be recognised as the common meeting place for such officers and timber committees.

(2) Minor Products.—Inquiries regarding the market possibilities of minor forest products should continue to be dealt with at the Imperial Institute.

(3) Tariff on Forest Products.—Your Committee wishes to point out that if Empire trade is to be fostered the granting of preferential tarifis may be required and fully justified in certain instances. Moreover, existing tariffs might well be scrutinized carefully with a view to removing any perferences which are prejudicial to Empire trade in the forest products. The Committee has been informed of cases where a foreign timber receives a preference on import duties over Empire timbers which in the opinion of the Committee are equally good in all respects.

(Signed)
P. Z. CAVERHILL, (*Chairman*)
SIR WM. FURZE,
F. M. OLIPHANT,
J. RICHARDSON,
W. A. ROBERTSON.
C. C. WILSON,
A. V. GALBRAITH.

NOTE.—This report is in line with recommendation made by Bauro Committee in respect to research in Minor Forest Products and the setting up of a timber office in City of London.

FOREST PRODUCTS RESEARCH LABORATORY AT PRINCES RISBOROUGH.

The Forest Products Research Laboratory at Princes Risbrought has the equipment and staff trained for this class of work. It is, as we have explained, at present organized on a national basis to serve the needs of the United Kingdom only. It undertakes investigations at the request of the Forestry Commission into the uses of "home-grown" timbers, Apart from the occasional examination of Empire timbers at the request of commer-

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cial users in the United Kingdom, the laboratory at present undertakes investigations of an Empire character only on special occasions on payment of fees, and when such investigations can be fitted into its general programme. We think that an important service to the Empire might be rendered if satisfactory arrangements could be made for providing funds to enable the Laboratory at Princes Risborough to include the testing of Empire timbers as one of its normal functions.

We recommend that the Empire Marketing Board should investigate the possibility of securing an extension of the activities of the laboratory at Princes Risborough for this purpose. Some additional capital expenditure on equipment would be required and also some recurrent expenditure on staff. But we do not contemplate any very large addition under either head, though this is a matter which will require examination in detail.

An interesting feature of the organization at Princes Risborough is the presence on the staff of a special officer whose duty it is to be in constant touch with the timber market and with the users of wood and generally to act as a liaison officer between the scientific staff and the timber-using industries. He is described as a "timber utilization" officer. An extension of the forest products research laboratory to enable it to deal freely with Empire timbers would probably necessitate the appointment of a second timber utilization officer. We should consider this appointment an important part of our proposals in regard to Princes Risborough. If it ever became necessary to appoint yet further utilization officers to devote their whole time to the timbers either of a single Empire country or of groups of countries, we consider that the cost should be borne by the country or group of countries requiring that service.

(concluded.)

EPHEDRA.

The distinction that Ephedra has attained is due to the drug ephedrine, which it contains. The plant itself can claim a certain amount of antiquity and history, having been well-known to the

ancients. According to Pharmacographia Indica 'dried branches of the Huma (Persian name for ephedra) are still brought from Persia to India for use in Parsi ceremonials, and it is considered to have medicinal properties'. It has evidently been in use in China for a very long time, since it forms part of many prescriptions used in the Chinese medicine. The ashes of the plant are employed to increase the potency of snuff.

The alkaloid ephedrine was isolated from ephedra by Nagai in 1887 and was described as mydriatic. Its therapeutic value not being fully realised, it remained a chemical curiosity for a long time. It is only recently, that its importance in the cure of certain diseases has been discovered, consequently, the interest in the drug has been revived.

Lately, its use as an excellent substitute for adrenaline (harmonal constitutent of animal organism) has been discovered. Like adrenaline, ephedrine has a stimulant action, and its chief advantage over adrenaline for therapeutic use is its considerably greater stability. While adrenaline in solution has very little keeping power, solutions of ephedrine are stable and sterilisable. In contrast with adrenaline, ephedrine is only slowly destroyed in the body, and has, therefore, a considerably more prolonged action. It is only slightly affected by the digestive juices, and is therefore effective after absorption, when administered by mouth. As an addition to local anæsthetic, ephedrine is preferred to adrenaline for various reasons. Applied locally, it reduces swelling of the mucous membrane (especially in hay fever) and in the eye produces dilations of the pupil similar in degree to that caused by cocaine.

A difficulty in the preparation of the alkaloid has, hitherto, been dependent on the crude drug, which at times is difficult to obtain. Therefore, ephedrine and its various homologues (commercially known as ephetonin) have been prepared synthetically in the laboratory and claims have been made by certain manufacturers, from time to time, as to their suitability in medicine, being in almost complete pharmacological agreement with the natural drug. The medical profession being conservative, is naturally slow in adopting synthetic preparations and not without

reason in this particular case, since 'ephetonin' has lower efficacy besides being as costly as the natural ephedrine.

Up to the present, ephedrine had only been found in the Chinese plant, hence, the major portion of the drug came from that country. But owing to the disturbed conditions that were prevalent there last year, interest was taken in its supply from India. In response to an enquiry from the Wellcome Research Laboratories, England, samples of *Ephedra intermedia* were sent by the Conservator of Forests, Kashmir, both to England and to this laboratory for analysis. The results obtained were not very hopeful because of the low yield found in these specimens (about 0·2 per cent.) hence, not fit to be worked profitably on a commercial scale.

The alkaloid content of the Chinese Mahuang is supposed to vary from 0·018 per cent. to 1·32 per cent. The two factors that are contributory to these differences are the question of seasonal variation and the influence of altitude. Search was, therefore, made for other Indian species of ephedra that may yield higher quantities of the alkaloid. Consequently, the investigation of which the present note is a preliminary report was taken up in the Chemical Branch of the Forest Research Institute. *Ephedra intermedia* and *E. Gerardiana* from far off places in northern India (*viz.*, Hazara, Kashmir, Lahoul, Chakrata, Plas Kohistan, Razmak, Tochi valley, Kaghan, Phari) have been analysed. The results obtained indicate clearly that *E. Gerardiana* is very much richer in ephedrine content (about 0·5 to 1·3 per cent.) than *E. intermedia.* Besides, *E. Gerardiana* in itself varies considerably in alkaloidal content with the locality where it grows. For example, the one collected in Kaghan contains 1·3 % ephedrine while the samples from Chakrata averaged about 0·4 per cent. It has been reported by some workers in China that the yield of the alkaloid varies considerably with the season, the maximum being present when the berries have just formed. So that the samples collected in autumn contain about twice as much ephedrine as in those collected early in May. Work is proceeding on these lines in this department, and sufficient data

has not yet been collected to be able to express any definite opinion on this point.

Work carried out in this department and elsewhere has undoubtedly established the commercial values of *E. Gerardiana* and has shown that the Indian species are quite as rich, if not in some cases richer in ephedrine content than the Chinese species. Already a demand for Indian ephedras has been created in India and elsewhere. America alone imported 34 tons (918 mds.) during the last 12 months. The crude drug is priced in New York at about Rs. 0-15 a lb. (*Indian Forester* Trade Supplement 1927) so that Rs. 70,000 worth of ephedra is capable of yielding about 450 lb. of ephedrine (taking an average yield of 0·6 % valued at nearly 4 lacs. The above figures for the export of this drug from India represents only a fraction of the trade which has recently been developed in China. The following table gives the figures for export of 'Mahuang' (Ephedra) from Tientsin to foreign countries :—

Total export of 'Mahuang' from Tientsin to foreign countries from August 1926 to July 1928.

(From B. E. Read, Chinese Economic Journal, October 1928, p. 817.)

Year.		Quantity.
1926 August to December	...	1787 maunds.
1927 January to December	...	4265 ,,
1928 January to July ...	...	2854 ,,
Total	...	8906 ,,

The figures for export from the whole of China must be greater but the above figures represent the bulk of trade that exists.

Inspite of the fact, that a certain amount of synthetic drug (ephetonin) is being pushed in the market, the demand fo ephedra is increasing and is likely to increase still more as ephedrine finds a more extended application in medicine. There is no reason why the Indian ephedra should not capture the bulk of the trade, should the necessary publicity be given to it.

BOTANICAL DESCRIPTION.

The genus Ephedra belongs to a small family of flowering plants, the Gnetaceae which is characterised by having naked ovules, not enclosed in an ovary. There are 30 or more species widely distributed in Central and Western Asia, the Mediterranean Region, Atlantic Islands, Southern States of North America, the Andes from Ecuador southwards to Patagonia and the Eastern Argentine. They are all rigid, usually much branched, erect or climbing shrubs with scale-like or rarely filiform or subulate, connate leaves in alternating whorls of 2, rarely 3 or 4, sometimes reduced to sheaths. Flowers are small and unisexual and are aggregated together in few or many-flowered short spikes. They may be monoecious or dioecious.

Brandis (Indian Trees, 1906, p. 686) recognises 5 species occurring in India *viz., E. foliata* Boiss., *E. Gerardiana* Wall. (Syn. *E. vulgaris* Hook. f., in Flora of British India Vol. V, p. 640), *E. nebrodensis* Tineo., *E. intermedia* Schrenk & Meyer and *E. pachyclada* Boiss. Of these *E. nebrodensis* Tineo does not seem to differ from *E. Gerardiana* Wall, by any well marked characters and is therefore sometimes included in the latter. Similarly *E. pachyclada* Boiss., is considered synonymous with *E. intermedia* Schrenk & Meyer.

E. nebrodensis is said to occur in the juniper tracts of Baluchistan, 7-10,000 ft., Balti and Lahoul in India. In this connection it is interesting to note that the percentage of ephedrine extracted from *E. Gerardiana* collected both in Lahoul and the Trans-Indus territory is practically double of that found in samples of *E. Gerardiana* collected from other localities such as Chakrata, Kashmir, Hazara etc. Furthermore a sample of *E. Gerardiana* collected from its easternmost limit in Sikkim where

E. nebrodensis is not supposed to occur only yielded 0·1 % of ephedrine while the Lahoul samples gave as high as 1·1 %. It is, therefore possible that in this case we are dealing with 2 distinct species *E. nebrodensis* Tineo., having a higher ephedrine content and *E. Gerardiana* Wall with a lower percentage of ephedrine. Further investigation is needed to decide this point definitely.

The following analysis of the species is based on Mr. Parker's diagnosis in his Forest Flora of the Punjab and Hazara.

Tall scandent shrubs with slender branchlets ... ... *E. foliata*

Rigid erect shrubs with usually many stems from a short rootstock.

Male spikes 1-3 together at the nodes; internodes smooth or slightly rough, rather slender ... *E. Gerardiana.*

Male spikes in dense whorls at the nodes; internodes rough, stouter ... ... *E. intermedia.*

E. foliata Boiss.—Vern. Kuchar, Punjab.—A tall much branched shrub usually climbing over bushes and looking like certain species of *Calligonum.* Stem woody, about 3″ diameter; bark on the branches exfoliating in fibrous shreds; branches slender, usually fascicled; branchlets filiform, dull green in colour; internodes 1-4″ long. Leaf-sheaths very short with 2 triangular or linear teeth longer than the sheath and often prolonged into narrow linear leaves, which may sometimes be upto 1″ long. Male flowers in sessile or peduncled bracteate spikes which may be solitary or 2-3 together; flowers 6-24 in each spike; bracts rounded, obtuse. Anthers 3-4. Female spikes pedunculate, often in small terminal cymes. Fruit ovoid, ·3 in. long; seeds 2, dark coloured.

Distribution—Baluchistan, Sind, Kurram valley, Punjab plains, mainly in the southern portion. Salt Range up to 3,000 ft.

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E. Gerardiana Wall.—Syn. *E. vulgaris* Hook f. in Fl. Br. Ind. v. p. 640. Vern. Tutgantha, Jaunsar.—A low, rigid, nearly erect shrub, usually 1-2 ft. high; stems up to 1 in. diameter; branchlets slender, green, finely grooved, often curved; internodes ·5 to 1·5 in. long by about ·05—·1 in. diameter, striate, smooth or slightly scabird on the ridges. Leaf-sheaths ·08 in. long, 2-toothed. Male and female flowers in spikes, usually on separate plants. Male spikes solitary or in pairs, rarely in whorls of 3; flowers 4—8; filaments united in a column protruding from the perianth; anthers 5—8. Female spikes solitary; flowers 1—2, each consisting of a single erect, sessile naked ovule. Fruit ovoid, ·3—·4 in. long, sweet, edible, red when ripe.

Distribution—Hariab District, Kurram valley, 11,000 ft. Himalaya 8-14,000 ft., also in the inner arid tracts, ascending in Sikkim to 16,500 ft.

E. intermedia Shrenk and Meyer.—Syn.—*E. pachyclada* Boiss. Vern. Hum, Trans-Indus—A small erect shrub often glaucous; internodes 1 to 2·5 in. long by ·08 to ·16 in. diameter, usually more or less rough to the touch when dry. Leaf sheaths ·15 in long or a little less, 2-toothed. Male and female flowers in spikes usually on separate plants. Male spikes numerous in dense whorls at the nodes; flowers about 8; filaments united in a column protruding from the perianth; anthers 5—6. Female spikes often whorled at the nodes; flowers 2. Fruit ·3 in. long, ovoid, red when ripe.

Distribution—Baluchistan, N.-W. Himalaya, chiefly in the inner arid valleys; Chitral 4—5,000 ft. on dry, rocky slopes; Gilgit, Zanskar, Upper Chenab, Kunawar 6—9,000 ft.

Both *E. Gerardiana* and *E. intermedia* are sometimes confused with *Equisetum*—a non flowering plant but the latter is never woody, its stems are hollow and the leaves which are reduced to the teeth of a sheath are more numerous and embrace the internodes next to the one from which they arise.

Since the young twigs are the parts collected for commercial purposes, it is proposed to study the anatomy of the various Indian species to see if they can be easily identified from anatomical characters only.

EXTRACTION.

Although the alkaloid ephedrine was isolated as early as 1887 and its chemical constitution settled soon after, it was not till recently, when its therapeutic value became known and its demand in the market increased, that attention was paid to the methods of its extraction and assay. Various workers (Chen Chow, Masuci and Suto and Schortzow and Needham) have assayed ephedras but the results recorded by them differed, considerably. The method generally followed was the U.S.P. Method for assay of belladona roots. Read and Feng made a critical study of various methods for assay of Chinese ephedras and have introduced certain modifications. Thus they have obtained very good results by the process of direct alkalinization with sodium carbonate, extraction with chloroform and titration of the alkaloids isolated with standard acid. In this process, one characteristic property of ephedrine has been lost sight of, namely, its conversion into the hydrochloride when the alkaloid is extracted with chloroform and the solvent is removed therefrom, by evaporation. Mention was first made about this property of ephedrine by Paterson (Ind. and Eng. Chem. Vol. 20 (1928) p. 388). He did not study the mechanism of the reaction in detail, but in view of the fact that the reaction is not quantitative and that a certain amount of ephedrine is decomposed as the result of this reaction, he recommended the use of ether for final extraction. This peculiar behaviour of ephedrine has also been noticed in our work.

The quantitative experiments in this direction have convinced us of the fact that the extraction of the base with chloroform is not a suitable method. The following modification was, therefore, adopted.

One hundred grams of completely air dried (containing from 5 per cent. to 6 per cent. of moisture) and finely powdered green

stems of the drug were treated with 400 c. c. of a mixture of 3 parts ether and one part chloroform. After allowing it to stand for two hours, 50 c. c. of ammonia (3 parts strong ammonia and 1 part water) were added and the mixture was thoroughly shaken and kept over night. The extract was filtered off the next morning and the drug was treated again with the same volume of ether-chloroform mixture containing 30 c. c. of ammonia and kept over night. The process was repeated a third time. Bulk of the solvent from the combined extract was distilled off and the residue extracted with portions of 75 c. c., 60 c. c., 60 c. c., and 50 c. c. of 1·5 % hydrochloric acid. The combined HCl extract was filtered, made strongly alkaline with potassium carbonate, and saturated with common salt. The alkaloids thus set free were extracted four times with ether. The ether solutions were filtered through absorbent cotton previously soaked with ether. Bulk of the ether was then distilled off and the residue allowed to evaporate at room temperature. Excess of standard acid was then added to the residue and the excess of acid was titrated back with standard alkali, using methyl orange as the indicator. From the amount of acid neutralized by the base, the amount of alkaloid was calculated. The alkaloids thus separated from the drug are mixtures of several basic substances chief of which are ephedrine and pseudo-ephedrine. Ephedrine was isolated from pseudo-ephedrine by taking advantage of the difference in solubilities of their hydrochlorides in chloroform ; ephedrine hydrochloride being practically insoluble in the solvent.

The following table gives the total alkaloid content, as well as the ephedrine content of different species of Indian ephedras collected from different localities. The results of analysis of two samples of Chinese Ephedra (*Ephedra equisitina* and the other of *E. sinica* kindly supplied by Mr. B. E. Read of Peking Union Medical College) were also analysed under identical condition and the results obtained are included in this table for comparison.

Serial number.	Name of species	Locality of Cllection.	Month of collection.	Total alkaloids per cent.	Ephedrine per cent.
1	Ephedra foliata	...	...	0·03	nil
2	„ intermedia.	Razmak ...	August 1928 ...	0·17	0·11
3	„ „	Datta Khel ...	September 1928	0·12	0·09
4	„ „	Ladakh (Kashmir)	November 1927	0·82	en
5	„ „	do. ...	December 1927	0·81	0·31
6	„ „	do. ...	January 1927 ...	0·87	0·35
7	„ Gerardiana.	Phari (Tibbet Frontier ...	November 1928	0·29	0·10
8	„ „	Chakrata ...	June 1928 ...	0·79	0·37
9	„ „	do. ...	September 1928	0·83	0·48
10	„ „	do. ...	November 1928	0·49	0·30
11	„ „	Hazara ...	May 1928 ...	0·74	0·48
12	„ „	Kashmir ...	May 1928 ...	1·16	0·67
13	„ „	do. ...	August 1928 ...	1·18	0·66
14	„ „	do. ...	October 1928 ...	0·93	0·63
15	„ „	Lahoul ...	August 1928 ...	1·78	1·10
16	„ „	Plas Kohistan (Trans frontier independent territory.) ...	September 1928	1·14	0·84
17	„ „	Razmak ...	August 1928 ...	1·40	0·80
18	„ „	Kaghan valley	July 1928 ...	1·83	1·23
19	„ equisitina.	China ...	...	1·58	0·98
20	„ sinica	China ...	...	1·28	0·63

The limited use of ephedrine is to an extent due to its high price (Rs. 55 per ounce), and if by any method the prices could be brought down, it is probable that it would find a wider use in medicine. The difficulty that has hitherto attended its

extraction has been the fact that the alkaloid is decomposed by heat and is easily transformed into the isomeric alkaloid pseudo-ephedrine, in contact with acids. Pseudo-ephedrine i of no therapeutic value, in fact, its admixture with ephedrine o ephedrine preparations is considered as distinctly injurious. In order to prevent its formation it is usual, therefore, to extract the drug by chloroform, alcohol or ether in the cold. Complete recovery of these solvents, after extraction, is never possible hence the loss in the solvent raises the price of the drug considerably. The following process which has been evolved after a considerable amount of preliminary work appears to be the cheapest way of extracting the alkaloid on a large scale.

One kilo of the finely powdered drug (consisting of green twigs only) were macerated with 5 litres of cold 0. 5 % HCl and kept over night. The acid extract was squeezed out. The operation repeated twice using 3 litres of acid each time. The mixed acid extract (11 litres) was filtered and neutralised with sodium carbonate till it was just neutral to congo but acidic to litmus. It was then evaporated on water bath to about 800 c. c. and later, made strongly alkaline with sodium carbonate The precipitate formed was separated and washed with strong brine and the washings added to the filtrate. To the filtrate which contained the bulk of the alkaloids a large amount of common salt was added and then extracted with ether, four times. The solvent was removed by distillation. The alkaloidal residue was then converted into the hydrochloride on treatment with dilute aqueous HCl, till neutral point was reached. The solution was concentrated by evaporation at a temperature of 45°—50°C, when the hydrochlorides crystallized out. The dried hydrochloride on treatment with dry chloroform dissolved out the hydro chlorides of other bases present (chiefly pseudo-ephedrine) leaving pure ephedrine hydrochloride behind. A further quantity of ephedrine was recovered from the precipitate, previously removed, by boiling with benzene. It was found that five-sixth of the total alkaloids was present in the filtrate and one-sixth in the precipitate after alkalinization with sodium carbonate. The

following table gives the percentage of ephedrine obtained in this manner :—

		Total alkaloids.	Ephedrine.
Extraction with HCl	...	1·33%	0·60%
Extraction with ether—chloroform mixture, of the same sample...		1·28%	0·63%

The result shown above is interesting. It shows very clearly that the conversion of ephedrine into pseudo-ephedrine does not take place in contact with hydrochloric acid of the above strength and at temperature of 25°C ; as has hitherto been supposed.

There can be no doubt that the above process is superior to extraction with alcohol which dissolves a large amount of chlorophyll, colouring matter and resins etc., along with the alkaloids. An amount of alkaloid is lost in the marc when the alcoholic extract is treated with dilute acid.

The physiological properties of the isomeric alkaloid pseudo-ephedrine which occurs to the extent of about 25 per cent. of the total alkaloids present in *Ephedra Gerardiana* has not yet been fully studied. But according to Mr. B. E. Read, investigations so far carried out show that this alkaloid also holds out promise of being useful as a diuretic (Chinese Economic Journal, October 1928).

The authors are greatly indebted to Mr. F. D. Ardagh, Officer-in-charge, Minor Forest Products Section, for his interest and help.

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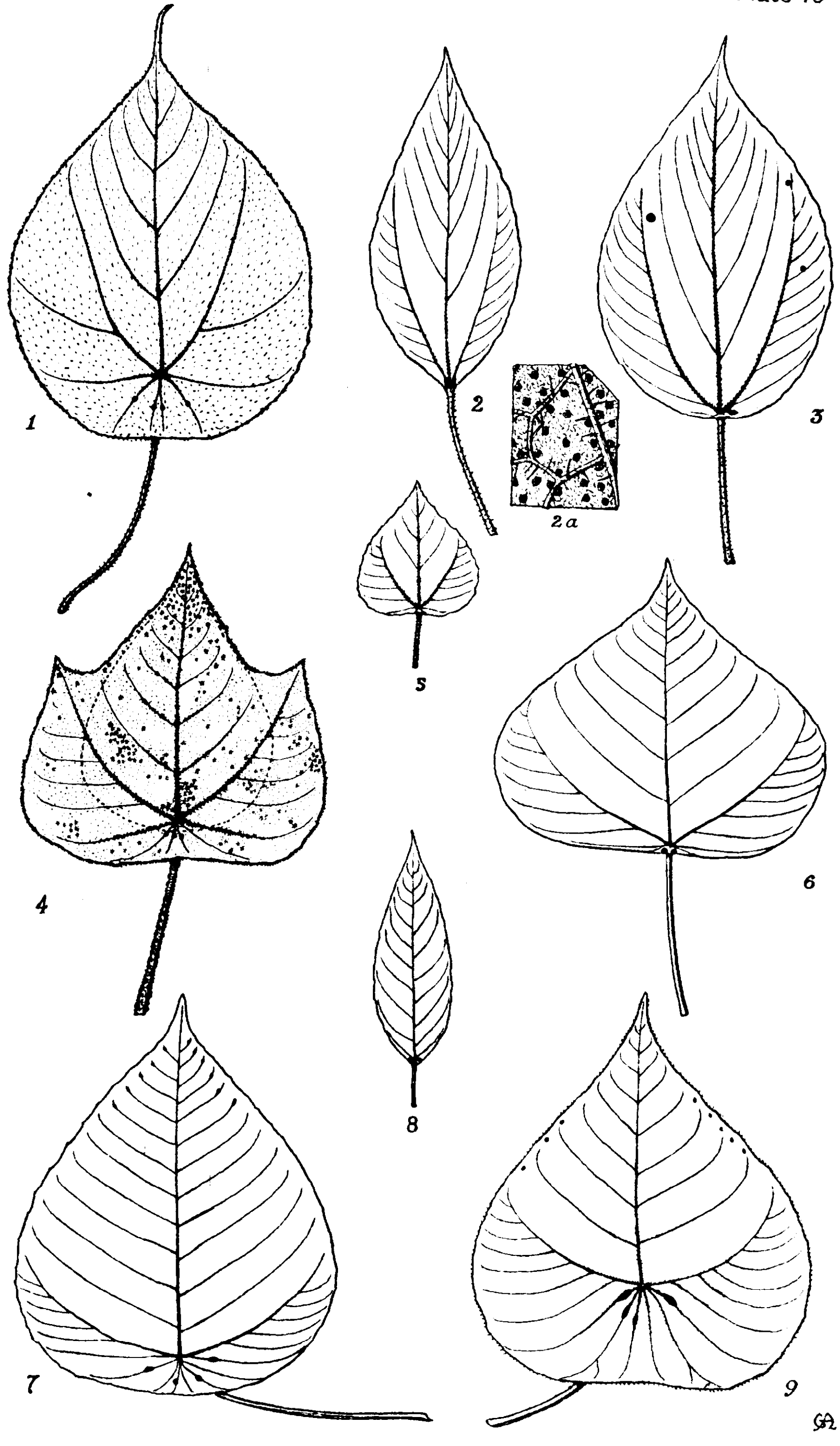
THE MALATAS OF NORTHERN BENGAL.

By J. M. Cowan.

In Northern Bengal, which is here taken to include the Districts of Darjeeling and Jalpaiguri, there are altogether nine species of the genera *Mallotus* and *Macaranga*.



1. Mallotus Roxburghianus, 2. M. philippinensis, 3. M. nepalensis, 4. M. albus, 5. M. repandus, 6. Macaranga pustulata, 7. M. denticulata, 8. M. Gamblei, 9. M. indica. (All X $\frac{1}{7}$). 2*a*. Underside of leaf of M. philippinensis X 12.

No. 932.

Three of these species can be readily recognised, but the remaining six, which are all small trees, very similar in general appearance and all known as *Malata* by the Nepalese, are easily confused, particularly when they are neither fruiting nor flowering.

The correct determination of these species is the more difficult for the worker in the field as detailed descriptions are not readily accessible to him and further, species which are only to be found elsewhere have been identified with local plants, while several of the latter have synonymous names.

Descriptions of the nine species found in Northern Benga are given here in sufficient detail for ready determination; the outstanding characters of each species being printed in italics.

The key is based upon leaf characters alone, so that with the help of the accompanying figures it may be possible to determine the species from a leaf specimen or when a tree is found in leaf only.

Fuller descriptions are published in Engler's Pflanzenreich IV. 147. VII.

MALLOTUS ALBUS Muel. Arg. *Jogi Malata.*

A small tree up to 30 ft. high in the plains and in the valleys to an altitude of 5,000 ft. Dioecious. Leaves orbicular-to triangular-ovate or 3-lobed, acuminate truncate or sub-cordate, entire or obscurely dentate; shortly, rarely deeply ($1\frac{1}{4}$ ins.) peltate; 3 to 14 ins. long, $2\frac{1}{2}$ to 12 ins. broad with 3 principal and 2-4 subsidiary radiating basal nerves, and with 2 (or more) glands on the nerves near the insertion of the petiole; glabrous above except on the nerves, covered *beneath* with *a dense-white or rusty-white stellate tomentum.*

Infloresence terminal, bracts minute. Male flowers clustered on the branches of the panicle, sepals 3-4, stamens numerous (70). Female flowers on a spreading panicle, sepals 4-5, *ovary 4 celled,* covered with white tomentose appendages, styles 3-6, *usually 4,* feathery.

FIG. 4.

MALLOTUS NEPALENSIS Muell. Arg. syn. *M. oreophilus* Muell. Arg. *Malata.*

A small tree up to 30 ft. high, frequent at elevations between 5,000 and 8,000 ft., common about Darjeeling. Dioecious. Leaves

triangular to orbicular-ovate, entire, acuminate, truncate, *cuneate* or sub-cordate, very shortly and inconspicuously peltate, 4 to 10 ins. long, 2 to 8 ins. broad, with 3 principal basal nerves, prominent beneath and with 1-2 pairs of subsidiary radiating nerves; glabrescent above, *yellowish-green* or *buff* and *soft* with a dense stellate tomentum *beneath*.

Infloresence terminal, bracts small linear. Male flowers shortly and *stoutly pediceled* clustered on a 6 to 12 in. rachis; sepals 4, 3-nerved, stamens very numerous (100). Female flowers *closely crowded* on a 7 to 14 in. rachis, sepals 3-4, ovary densely tomentose and covered with soft flexuous appendages. Style 3-fid, lingulate, shortly protruding.

FIG. 3.

MALLOTUS PHILIPPINENSIS Muell. Arg. *Sindure.*

A tree attaining 40 ft. found in drier localities in the plains and lower hills to an altitude of 4,000 ft. Dioecious. Leaves *ovate* or *ovate lanceolate*, acuminate, cuneate or sub-rotundate; 2½ to 10 ins. long, 1½ to 4½ ins. broad, with three main nerves and two glands at the insertion of the petiole. At once recognised by the numerous *small red glands* on the *underside* of the *leaf*. Infloresence terminal or axillary. *Capsules* densely covered with *red granules*.

FIGS 2 AND 2a.

MALLOTUS REPANDUS Muell. Arg.

A *large climber* of the plains and lower hill forests. Similar in appearance to the common *Croton caudatus* Giesel. *Supare* or *Halonre*. Leaves triangular-ovate 1¼ to 3 ins. long, 1 to 2¾ ins. broad, very shortly and inconspicuously peltate, with 3 main and 2 (or more) subsidiary basal nerves. Flowers in terminal or axillary panicles.

FIG. 5.

MALLOTUS ROXBURGHIANUS Muell. Arg. syn. *Rottlera peltata* Roxb. *Phusre Malata.*

A small tree of the damp valleys in the lower hills. Dioecious. Leaves orbicular to orbicular-ovate with a long *acuminate tip*, base rounded, *broadly peltate* (½ to 1½ ins.) 5 to 10 ins. long, 3½ to 7 ins. broad, with 9 basal nerves; *hirsute* above and below

e specially on the veins, with many stellate hairs. Margin entire or denticulate with or without glands at the extremity of the nerves and intermediately and with or without small glands on the decurrent basal nerves. Infloresence *terminal,* bracts linear, male flowers in clusters, shortly and *slenderly* pedicelled, sepals 4-5, stamens numerous (30). Female flowers *clustered* on a 9 to 13 in. rachis, ovary covered with flexuous appendages. Style short, stigmas 3, feathery.

FIG. 1.

MACARANGA DENTICULATA Muell. Arg. syn. *M. gummiflua* Muell, Arg. *Malata.*

A common tree attaining a height of 60 ft., often in grass and coming up abundantly in clearings, found in the plains and on the hills to an altitude of 5,500ft. Dioecious. Leaves triangular, orbicular or broadly ovate, entire or denticulate, acuminate, base rounded or truncate, peltate ($\frac{1}{2}$ to $1\frac{1}{2}$ ins.) rarely cordate, 3 to 13 ins. long, $2\frac{1}{2}$ to 12 ins. broad, with *10-12 basal radiating nerves,* several of the decurrent nerves bearing small glands; glabrous when mature, tomentose when young, the underside with numerous small yellow glands, the upper side with *marginal glands near the apex.* Flowers in axillary panicles, $1\frac{1}{2}$ *to* $3\frac{1}{2}$ *ins. long,* bracts small triangular. Male flowers, sepals 2-3, stamens 9-15 anthers 4 locular. Female flowers, calyx *cup shaped* 2-3, partite *stigmas* 2 lingulate, shortly protruding. Fruit 2-3 locular $\frac{3}{16}$ *ins. in diameter.*

FIG. 7.

MACARANGA GAMBLEI Hk. fil.

A small tree of damp forest in the Terai. Leaves *elliptic lanceolate, penni*—or obscurely 3-*nerved,* 3 to $4\frac{1}{2}$ ins. long, $1\frac{1}{2}$ to $1\frac{3}{4}$ ins. broad, with two glands on either side of the midrib, glabrous and with minute dark glands below.

FIG. 8.

MACARANGA INDICA Wight. *Malata.*

A tree 30 ft. high of the damper localities in the plains and lower hills to an altitude of 3,000 ft. Dioecious. Leaves orbicular-ovate, acuminate, rotundate, *broadly peltate* ($1\frac{1}{4}$ to $2\frac{1}{2}$ ins.), 5 to 16

ins. long, 4½ to 11½ ins. broad, with 9 radiating nerves, *two* (rarely more) *large elongate glands* on the outer decurrent pair; mature leaf glabrous with *marginal glands* on the upper side *some distance below the apex* and small scattered glands on the underside. Infloresence axillary 3 to 10 ins. long, with *zig-zag* branching. *Bracts with a prominent dark coloured gland* at their tip. Male flowers, sepals 2-3, stamens 5-8. Female flowers sepals 2-3, *stigma lateral* ovary *7-locular* $\frac{3}{16}$ ins. in diameter.

FIG. 9.

MACARANGA PUSTULATA King. (including *M. gmelinaefolia* King) *Malata.*

A small tree of the hill forests to an elevation of 6,000 ft., common on Dumsong. Dioecious. Leaves triangular or orbicular-ovate, acuminate, truncate, subcordate, or cuneate, very shortly and inconspicuously peltate, 4 to 7 ins. long, 3½ to 6 ins. broad, with 3 main basal nerves and 2-4 subsidiary radiating nerves and with 2 *glands close to the insertion of the petiole*, glabrescent above, underside dotted with minute glands. Infloresence in axillary panicles 2½ to 4 ins. long, bracts ovate, acuminate. Male flowers, sepals 3, stamens 15-20. Female flowers, stigmas 2 on a short style. *Fruit* 4 *lobed*, 2 seeded, ¼ *in. in diameter.*

FIG. 6.

KEY TO THE SPECIES.

A. Leaves peltate, midrib inserted at least ¼ in. from the base of the leaf.

(*a*) With stellate hairs: mature leaf villous or tomentose beneath.

α. Underside white or rusty-white with a dense tomentum. ....*Mallotus albus.*

β. Underside green or yellowish-green, hairy especially on the veins and veinlets......*Mallotus Roxburghianus.*

(*b*) Without stellate hairs: mature leaf glabrous.

α. Basal ribs 10-12, marginal glands near the apex-bracts leaf-like...............*Macaranga denticulata.*

β. Basal ribs 9, the outer descending pair with 2 elongate glands, marginal glands some distance below the apex, bracts with glandular tip...*Macaranga indica.*

B. Leaves not peltate, or midrib inserted not more than $\frac{1}{8}$ in. from the base of the leaf.

(*a*) Leaves about as broad as long.

α. Small trees.

(i) Leaves glabrous.........*Macaranga pustulata.*

(ii) Leaves tomentose whitish below......*Mallotus albus.*

β. Climbing shrub.. ....*Mallotus repandus.*

(*b*) Leaves much longer than broad.

α. Underside dotted with bright red glands (Fig. 2a) ....*Mallotus philippinensis.*

β. Underside without bright red glands.

(i) Underside with a yellowish-green tomentum, leaves ovate 4-10 ins. long............*Mallotus nepalensis.*

(ii) Underside glabrous, leaves lancolate 3-4½ in. long..........................*Macaranga Gamblei.*

A NEW SPECIES OF VATERIA.

In June 1926 specimens of fruit of Vateria were received in the Herbarium from the Forest Range Officer, Bolampatty Range, Palghat Division, Madras. They were collected by Mr. H. A. Latham, at the time Conservator of Forests, Sixth Circle, Madras. As the fruit looked different in shape and size from those of *Vateria indica* Linn., flowering specimens were asked for, which were received in March 1927. On examination it was found that the specimens represented a hitherto undescribed species of Vateria.

Vateria macrocarpa B. L. Gupta (Dipterocarpaceae); affinis V. indicae Linn. sed floribus majoribus, forma at magnitudine sepalorum at fructuum inter alia differt.

Tree: young shoots and inflorescence covered with hoary stellate pubescence. Leaves entire, coriaceous, elliptic-oblong or

oblong-lanceolate, shortly acuminate, rounded or subcordate at. the base, glabrous on both surfaces, rarely with a few minute stellate hairs on the midrib beneath, chiefly at its base; lateral nerves 16-20 pairs, parallel, strong beneath, as well as the midrib; petiole 2·5-6 cms. long, swollen at the top, minutely pubescent; blade 15-25 cms. long by 6-12 cms. broad (often much larger in coppice shoots); stipules deciduous. Flowers 3·3 cms. diameter, in axillary, hoary stellate pubescent panicles, shorter than the leaves; pedicels 1·5-2·4 cms. long, jointed a little below the middle. Calyx divided nearly to the base, lobes 5, imbricate, triangular, acute, 3 mm. long, minutely and sparsely stellate-pubescent outside, silky-tomentose within, not enlarged in fruit Petals 5, 1·5 cms. long, elliptic, minutely apiculate, coriaceous, glabrous on both surfaces. Stamens numerous; filaments very short, 2 mm. long; anthers linear, glabrous, 7 mm. long, connective prolonged beyond the anther cells into a subulate point. Ovary superior, densely tomentose, 3-celled, cells 2-ovuled; style subulate, slightly longer than the stamens; stigma minute. Fruit 11 cms. long by about 6 cms. broad, ovate, narrowed towards the apex, coriaceous, splitting from the top downwards at maturity into 3 1-seeded valves. Fruiting calyx small, deflexed; cotyledons fleshy

Muthukulam, Bolampatty Range, Palghat Division, Madras, Herb. Dehra No. 43696. Fl. Sept. Fruit June.

This species can easily be distinguished from *Vateria indica* Linn. by the larger size of the flowers, smaller, triangular acute sepals and the larger ovate, shortly acuminate fruit. The petals are about 4 times as large as the sepals whereas in *Vateria indica* they are hardly twice as large. The indumentum of the two plants and specially the calyx is also characteristic, being more or less densely scurfy in *Vateria indica* and only consisting of a few stellate hairs in *V. macrocarpa*. The fruit in *V. macrocarpa* is ovate in outline (not ovoid or oblong) narrowed towards the apex and is nearly twice as large as in *Vateria indica*.

DEHRA DUN,
1st February 1929.

B. L. GUPTA,
Assistant to Forest Botanist.

GANGA SINGH DEL.

VATERIA MACROCARPA, B. L. GUPTA.

SURVEY OF THE WASTE LAND OF NORTH COUNTY, WICKLON, SUITABLE FOR AFFORESTATION.

BY S. LEONARD.

(*Vol II, No. 23 of the Economic Proceedings of the Royal Dublin Society*).

We have received from Professor A. Henry a copy of the above which is of interest to foresters in view of the wild statements still made by people having no knowledge of forestry of the large extent of waste land in Great Btitain and Ireland suitable for afforestation.

A classification of the land of this County was made showing on the map:—(1) Moorland; (2) Land suitable for afforestation; (3) Hill pasture; (4) Arable land, low lying bogs, etc.

Out of a total area of 195,154 acres and 104,000 acres of waste land, only 11,900 acres were found suitable for afforestation.

The land selected was considered from two points of view, shelter and soil conditions, both equally important in the British Isles. Without adequate shelter from the south-west wind trees cannot be grown at a profit, and to plant areas of heavy peat is seldom a financial proposition. The land selected as suitable was mostly covered with gorse (*Ulex europaeus*) and bracken (*Pteris aquilina*) indicating a mineral soil usually of a dry character capable of supporting trees.

This is a further instance of the usefulness of plant indicators in the valuation of any given site for forestry purposes.

GRASS LAND, ITS MANAGEMENT AND IMPROVEMENT.

BY R. G. STAPLEDON AND J. A. HANLEY.

(Clarendon Press, Oxford 1927. 5sh.)

In view of the increasing attention which is being directed to the improvement of pastures, not only by the agriculturist and stock breeder, but also by forest officers, the title of this book suggests that one might get from it some ideas for consi-

deration in the management of the grazing grounds included in our reserved forests. Perusal reveals the fact that its outlook is not buite wide enough to cover adequately our problems, as it is written for English conditions as regards the grassland itself, the treatments possible, and the attitude of the stock owner, all extremely different from those prevalent in India. There are, however, some sections which all should read who come into contact with grazing—and which of us does not? Thus captions such as "The Grazing Animal a necessity for the Maintenance of Grass Land", and 'The effect of time of cutting on the Quality of the Hay and on the Character of the Sward', and 'The Effect of Grazing on the Herbage at Different Seasons of the Year',— these all deal with points about which one feels one should know more. There are 8 pages of titles of selected literature, though most of the books and papers are not easily accessible in India; a more convenient arrangement would have been by subjects rather than authors, particularly as no references are given in the text.

H. G. C.

BIRDS, (NEW EDITION) VOL V. OF THE FAUNA OF BRITISH INDIA.

WRITTEN AND EDITED BY STUART-BAKER.

This volume contains the diurnal birds of prey, pigeons and game-birds. From the sportsman's point of view this is not quite so handy an arrangement as that of the original edition in which the pigeons, game-birds, snipe and ducks were all in Vol. IV; the volume so often found missing from our libraries.

The difficulty of trinomial nomenclature for those who have not a large series of skins for comparison is brought out very clearly in this volume. The key on page 60, for instance, calls up the picture of a puzzled naturalist holding a kestrel and trying to make up his mind whether the bird is the "palest form admitted" or "intermediate in colour" or "darker and more rufous." This is bad enough but, if he finally plumps for the third alternative, he is expected further to decide whether the "darker" is

"darkest", "nearly as dark" or "least dark". It is, of course, impossible in such cases to determine the sub-species of an isolated specimen, nor is this of any great importance in a single locality regarded by itself, unless and until other specimens are found there sufficiently different to suggest a separate origin.

The fact is that Ornithology has gone further than most branches in the classification of forms, and the results of this investigation into the geographical distribution of sub-species of birds are likely to be of the greatest value to science generally. If an equally detailed classification were made among elephants, for instance, a Burmese and Ceylon sub-species could, no doubt, be separated from the Indian type and, possibly, "north-bank" and "south-bank" races of the Bengal and Assam elephants might be recognised by naturalists as they are by dealers. Anthropology is handicapped by much inter-breeding between widely different races and it would probably not help matters to apply the trinomial nomenclature to mankind, though, at first sight, it may seem an anomaly for science to split the kestrels while she is still prepared to lump the Australian aborigine and the Chinaman, the pygmy and the "blue-eyed Dame" under the one specific name of Homo sapiens.

The coloured plates of the Emerald dove and Painted sandgrouse are old favourites with which no one will find fault but the three new plates of pheasants are disappointing. They are too vague to be of use for identification while, to regard them rather as works of arts, invites comparison with the glorious plates by such artists as Archibald Thorburn in Beebe's costly monograph. The black-and-white plates which illustrated Stuart Baker's article on the classification of the pheasants in the Bombay Journal some years ago made the identification so clear that it seems a pity they could not have taken the place of these three plates. The one representing the Black-breasted kalij is perhaps the least successful. The dark forest (which judging by the density at this point seems badly in need of thinning) is presumably intended for "Assam evergreen" but reminds one more of a drop-scene from the Babes in the Wood, an illusion

which is enhanced by a sort of effect spot-light on the face of the hen. Most of the plates in the earlier volumes, especially those by Gronvold, were so well executed that the pheasants suffer by contrast.

This volume maintains the high standard of excellence set by the rest of the work and the author is to be most heartily congratulated on the approaching completion of a colossal task in an amazingly short time.

E. O. S.

EXTRACTS.

Mr. E. R. STEVENS.

Extract from speech of Sir Montague Butler, when opening the Central Provinces Legislative Council on January 17th in referring to the inauguration of the Forest Committee:—

"Then came the sudden and lamented death of your late colleague Mr. Stevens, the Chief Conservator of Forests, without whose help and guidance it was difficult to make a start. He was one of those many Englishmen who have given of their best to the country of their adoption; a good friend to all, and a loyal servant of the State".

HOME PRODUCTION OF TIMBER.

THE SOCIETY OF FORESTERS.

The Society of Foresters has just concluded its first annual excursion. Formed last year for the purpose of bringing together profesional foresters and all those interested in the various technical and scientific aspects of forestry, the society decided to inaugurate its activities with an inquiry into the conversion and exploitation side of the subject. Among those attending the excursion were Dr. Sutherland, of the Forestry Commission, Sir Peter Clutterbuck, Major Strang Steel, M.P., and officials from the Forest Products Laboratory at Princes Risborough.

It is well known that by far the greater part of the timber used in this country is imported from abroad. Any one who has had timber to sell is aware that many consumers employ foreign timber not only from necessity but by choice. "Oregon Pine," for example (the trade name for Douglas Fir timber), is imported in enormous quantities; homegrown Douglas is often almost unsaleable. In their 1928 excursion the Society of Foresters endeavoured to ascertain the precise justification (if any) for this prejudice in favour of the imported article, and the methods of growing, preparing, and marketing the home product that will enable it to take the place of the foreign one. The inquiry represented, in fact, an attempt by the producer to get into the closest possible touch with the consumer.

One day was spent at Lake Vyrnwy in Wales. Since 1897, 2,400 acres of this catchment area have been afforested by Liverpool Corporation, working (in part), in conjunction with the Forestry Commission. The plantations were visited, and such questions as choice of species, planting distance, pruning, thinning, felling, extraction, and utilization discussed in detail. The remainder of the tour was spent at Liverpool. Visits were paid to the sawmills of Messrs. Webster, to several timber yards and warehouses, and to the grading sheds at Liverpool Docks. Amid the wealth of rare and beautiful timbers coming mainly from tropical regions it was satisfactory to find that few surpassed in beauty and value a specimen of native walnut from Northamptonshire, priced at 30*s* a cubic foot. Some members who had recently seen native Scots pine being converted on the estate sawmill at Gordon Castle in Aberdeenshire remarked that it was about equal in quality to the pick of the imported pine timber seen at Liverpool. On the last morning a visit was paid to the bobbin and shuttle mills of Wilson Brothers Bobbin Company, Limited. which have an annual consumption representing about 1,000 acres of growing trees, the whole of a fair-sized forest. The wood used here is mainly native beech and Finnish birch.

At the end of the tour there was a general feeling among the members present that much light had been thrown on the

requirements of the consumer, and on the ideals that the producer should aim at in growing his woods. It was agreed that on the whole the soil and climate of great Britain compare favourably for timber production with those of the European mainland and of North America. The problem is really one of choosing the right species, of producing straight, clean stems by timely pruning and thinning, of careful seasoning, of a regular supply, and of grading the finished product so that the purchaser may know what he is buying The conclusions reached by the Society are likely to have considerable influence on the future management of national and private forests in this country. Not the least important point that emerged was the agreement between the local Timber Trades Association on the one hand and the Society on the other as to the importance of maintaining at all times close contact and working in concert towards the realization of a common objective.

(*The Times.*)

MIXED CULTURES OF TEAK AND OTHER TREES.

(Roosendael, J van. Doelbewuste kunstmatige menging van djati met wildhout. *Tectona*, Buitenzorg, 1927, Vol. 20, No. 12 pp. 1003-1020).

It is generally recognized that, in order to keep the soil in good condition, *djati* (teak or *Tectona grandis*) must be cultivated in mixed culture with other kinds of wood. In 1915 only 20 per cent. of the *djati* fields were mixed with other woods, in 1925 however, 80 per cent. were planted in mixed culture. It must be kept in mind, that in this calculation the fields, where the original forest trees were partly left standing, are also considered as "mixed". The advantages of the mixed culture are, according to Beekman, the following :—(1) increase of humus formation ; (2) better protection of the soil against rain and sunlight ; (3) less danger of fire ; (4) the soil is better penetrated by the different roots ; (5) the spread of pests and diseases is hindered ; (6) wind damage is less to be feared ; (7) a better system of thinning cut can be obtained ; these advantages result in a better yield of teak and of other woods.

It is only by experimental plots, planted in different localities with different system of interplanting that the best combination can be found. The following systems are followed—

1. *On good soil.*—75 per cent. *djati*, 25 per cent. other wood, or 62½ per cent. *djati* and 37½ per cent. other wood. A scheme is given of last mentioned system, in which *djohar* (*Cassia siamea*) and mahogany (*Swietenia* sp.) are used for interculture and *kemlandingan* (*Leucaena glauca*) for interplanting of the second order.

2. *On soil of medium quality.*—Two systems are tried. One with 50 per cent. and one with 25 per cent. *djati*. Again *djohar* and mahogany are used for interculture, and *kemlandingan* for interplanting of the second order.

3. *On soil of poor quality*—Generally *djati* is not planted in such soils, but a trial may be made of planting a row of *djati* and 8 rows of other wood. A system is followed on the experiment plots, by which the rows are planted alternately in the following way:—row 1 *djohar* and *kemlandingan* (alternately), row 2 mahogany and *kemlandingan* (alternately), row 3 *djohar* and *kemlandingan*, row 4 *djati* etc. Between each two rows a row of "undergrowth" is planted. For this purpose the following plants are recommended:—*kesambi* (*Schleichera oleosa*), *girang* (*Leea* sp.) *kedinding* (*Albizzia lebbeckoides*) *walikoekoen* (*Actinophora fragrans*) *kesombo kling* (*Bixa orellana*) *kembang sepatoe* (*Hibiscus* sp. div.), *langon* (*Salvia occidentalis*.)

(*International Review of Agriculture June 1928.*

TUNG OIL

(The "Tung Oil" or "Wood Oil" of China is now extensively exported for making paints and varnishes etc. both in Europe and America. The oil is obtained from the seeds of *Aleurites*, and locally a distinction is made between "Tung Oil" and "Wood Oil", the former being obtained from the seeds of *Aleurites montana* and the latter from *Aleurites Fordii*. This has been confirmed by botanical examination. They are both included under "Wood Oil" in respect to exports to foreign countries. Various processess have been devised and patented for the employment of the oil in the manufacture of linoleum, waterproof, rubber substitutes, and in the preparation of reinforced concrete. It is also used in the preparation of paint driers in combination with lead and manganese and sold as "tungate driers". *Aleurites montana* and *Aleurites Fordii* are practically non-existent in India, but India possesses a species of *Aleurites triloba* which, though not strictly indigenous, has become domiciled almost everywhere. Originally a native of Malaya, it has been naturalised to the extent that it stimulates indigenous growths. Its fruits are known as *Desi* or *Jangli Akhrot*, while in the Deccan it is known under the name of Belgaum Nut though it is difficult to satisfactorily explain how it came to be so called. It is abundant in several Forest Divisions in Burma, which alone can provide 10,000 to 15,000 tons of ripe fruits per annum. There the oil is even now utilised to some extent in connection with Burma's lacquer-ware manufacture. Large quantities may also be obtained from Madras and Bombay, and the tree grows freely in Assam as well.

The process adopted in China for extracting the oil is extremely simple, and it willnot be difficult to employ the same methods here, or even to improve upon them. The seeds are first crushed in a circular trough beneath a heavy stone wheel worked by horse or ox power. The comminuted mass is then partially roasted in a shallow pan, after which it is placed in a wooden vat, fitted with a wicker bottom and thoroughly steamed over a cauldron of boiling water. Next with the aid of an iron

ring and straw, it is made into circular cakes about 45 cm. in diameter and 15 cm. in thickness. These cakes are arranged edgeways in a large wooden press which accommodates about a dozen. When full pressure is exerted by drawing in one wedge after another, it serves to crush out a brown, somewhat watery, heavy smelling oil that falls into the vat below. The yield is about 40 per cent. by the weight of the kernels, and the refuse cakes furnish a highly nitrogenous manure for the fields. Of late years this oil has been adulterated in China with the oil of the lacquer-varnish tree, bean oil and sesamum.

Some chemical analysis has been undertaken in London by the Imperial Institute, but it is doubtful whether any serious attempts have ever been made to determine the constants of the oil from *Aleurites triloba* with a view to its industrial utilisation. Anyhow the product is well worth an experiment, when so much material is merely running to waste.

(H. C. B. *in "Capital".*)

THE PLOUGH.

[*The following extract taken from an article by A. P. Cliff, Deputy Director of Agriculture, in the March 1928 Number of the Agricultural Journal of India should be of interest to Forest Officers. I myself have always noticed that no matter what implement or machine is used, if it is drawn by cattle it will always turn left, and if any effort is made to alter this, chaos reigns. Ed.*]:—

People who work much among the cultivators generally understand that the Indian plough bullock always turn to the left and never to the right. This is one of the apparently simple obstacles one meets and dismisses lightly, but can never surmount; because, no matter how well trained our farm bullocks and ploughmen are, nor how well, under our eye, the cattle turn right or left as required, no sooner do the men and cattle get away to their own or a cultivator's field then they turn left at once and all the time. On our land the responsibility is ours and the danger also; but on their own land they take no risks, but believe in "safety first" and their cattle turn only to the left.

In small plots with cattle turning left, inevitably ploughing is done from the outside to the middle if the plough allows; and a mouldboard that throws to the right not only allows but encourages this. So Indian cattle and a right hand throwing plough ploughs the field outwards time after time, till the centre is a hollow and the edge a containing rim; and the consequent waterlogging and deterioration of the soil is laid at the door of the English plough, and we are told in all seriousness that an English plough spoils the soil.

This is one of the eastern customs which many have tried to break and all have failed and will fail, at any rate for a few more centuries, and the only sound way to deal with it at present is to accept it and supply a plough to suit it. As far as I know, there is no difference whatever between a plough throwing right and the same plough built to throw left. Produced on the same scale, one is as cheap as the other; and the work done by both is the same, if equally intelligently used. But with bullocks that turn to the left, a right throwing plough is never intelligently used; while a left throwing one can only with difficulty be used otherwise. For India, therefore, all mouldboard ploughs supplied should be left-handed, to turn earth to the left; and with them the ryot will find it very difficult to do other than plough his plots up to the middle, with consequent improvement of drainage and crop bearing capacity. This is the first and fundamental consideration to be kept in mind.

The second is the necessity for some form of compensation for the difference between the furrow width and the draught width. We all know that ploughing is a slow, laborious process, that costs heavily in proportion to other agricultural operations; but that if done thoroughly, it is well worth while because at one operation the whole bulk of earth to the depth we are working is cut off from below, thoroughly shaken and broken, and turned over on the top of weeds and rubbish. One ploughing is the equivalent of 6 or 8 "chases" with the country plough or of 2 or 3 cultivations. But only if it is done properly.

For a mouldboard plough to plough properly it must tend to run with its share flat across the bottom of the furrow being cut,

at an even depth, and in a direction parallel to the last furrow, at a distance generally of 7 or 8 inches from it. For work with cattle in small plots we have already decided (*vide Agricultural Journal of India*, Vol. XXII, Part IV, pp. 288 and 289) that short pole draft is essential; so that little steering control is possible without sideways tilting; and such tilting must be avoided if feasible, as only when the plough is running flat and true is it doing its proper work. The first step obviously is to get the cattle to move in exactly the right direction and parallel to our furrow. There is only one line to guide them and that is the last furrow. On one side of that is a mass of clods and loose earth over which the bullock will wander in any direction but the right one, and on the other is the unploughed surface, generally a mass of weeds and rubbish. We must, therefore, make one bullock go in the furrow, when the other will keep his distance on the unploughed land. Any plough bullock will go quietly along a furrow with very little coaxing, though I defy anyone to drive a pair of ryots' bullocks straight along a given line, without that furrow to guide them.

The common plough yoke of India is 4 to 5 ft. long and the common distance between the necks of the bullocks is 40 to 48 inches. Half that, which is the distance from the neck of the furrow bullocks to the centre of the yoke, where the plough is 20 to 24 inches. But a plough furrow is only 7″ to 8″ rarely 9″ wide; so that though the hitch is 20″ away from the last furrow the plough must not be more than 9″, a difference of 11″ between draft width and furrow width. In western ploughs this difference is taken up partly by the length of beam and chain, and partly by the hake set across the end of the beam; but our draft must be a short pole and the hitch on the yoke only 6 or 7 feet from the plough.

There is commonly used on Bihar plantations a cheap copy of the old Hindustan plough which has short pole draught and of which the pole is directly over the landslide of the plough. When the bullock is in the furrow the plough tries to be 18″ away, and is forced back to the furrow by tilting it over on to its landslide, to the detriment of the ploughing. Then the bullock swings away

on to the land and the plough comes back into the last furrow. Not for 2 minutes together is the plough running square and true in its proper place and doing its proper work, because when the bullock is in the furrow, the only guiding line, the plough is too far away from it.

Some simple form of offset device is required on the plough so that the pole is attached 8″ or 9″ sideways from the landslide.

The bullock is in the last furrow, the yoke hitch is 18″ to the right, the pole is parallel to the work and the plough 9″ to the left of the base of the pole, is in its true position for easy and proper work. Without some such offset no mouldboard plough with short pole draught can be made to do good work; and ploughing, unless reasonably well done, is not worth doing. A few cultivations are simpler and cheaper.

It is possible to take up this difference between ploughing width and draught width by setting the pole at a small angle to the line of the plough; but this method is unsouud because a lengthening or shortening of the hitch on the pole, to suit higher or lower bullocks or to plough deeper or shallower, alters also the width of furrow taken; and with large bullocks a narrower furrow is taken than with small ones, the reverse of what would be desirable. The pole should be parallel to the line of the plough, but 9" to the side of it; and it is desirable to make this offset simply adjustable so that, for transport along roads, the offset can be closed up, the yoke brought back along the pole to lift the share and point off the ground and the plough slid home on its heel lying snugly between the heels of the bullocks.

It is most important to make the offset attachment an integral part of the body of the plough. Normally all such ploughs are sold in the *dehat* (village) without woodwork, and the construction of the plough body should be such that the pole can only be attached in one obvious way; as if the ryot is left any choice as to how the pole can be attached, he is certain to make the wrong choice. One cannot be too careful to make such a device fool proof, as even on Government farms it is common for an implement to be put together wrongly, if such a course is possible, and then it is often condemned without a fair trial.

It will be remembered that in discussing the ridge plough I suggested that such a plough might be sold, without handles or poles, to be fastened to the front vertical column of the Bihar $\frac{3}{5}$ tined cultivator. Similarly the single mouldboard plough might well be constructed to bolt firmly to the left side bar of the frame of that cultivator. Two holes in the plough frame in a horizontal line, to register with corresponding holes in the cultivator frame side member, and an extra vertical piece bolted firmly to the body of the plough and passing up and in, to the bolt where the pole and handles cross, provide an attachment rigid vertically and longitudinally. The cultivator frame itself provides the required offset. I have tested throughly such a plough and find it quite a practical outfit ; and again it is thought that the saving of pole and handles so possible, would be throughly appreciated by the ryot.

A final point apparently not generally appreciated is that the downward pressure on a plough point, *i e.* the pressure that makes the point dig itself into the ground, is less when the plough has short pole draft than when it has the usual beam and chain draft. To compensate for this, in any plough sold for use with short pole draft, the angle which the share and point makes with the line of the bottom of the plough, generally the lower side of the landslide, should be very appreciably greater than is usually the case ; otherwise the plough must be run on its nose, and the tail of the landslide and the rear of the mouldboard will be up out of the earth and the plough will not sit in the furrow securely nor turn the earth properly.

The writer advocates the following essentials for any plough to be marketed for the use of the Indian ryot :—

(1) Cheapness to be obtained by the use of light castings throughout.

(2) A detachable, invertible, slip in, cast point.

(3) Pole draft.

(4) Left hand throw.

(5) An offset device either (*a*) integral to the body of the plough whereby the pole is attached parallel to the

line of the plough but 8″ or 9″ to the right of the landslide, or (*b*) obtained by bolting the plough rigidly to the left side bar of the Bihar $\frac{3}{5}$ tined cultivator.

(6) An abnormally steep set of share and point.

Apart from these, such a plough should be of the short breasted, wide throwing, breaking type, capable of ploughing reasonably well any class of land from sandy loam to heavy clay, and it will then meet sufficienly well the requirements of the whole country. Two sizes are advisable—

(1) About the size of the Punjab plough for tracts where bullocks are large, and for estates, Government farms, etc.

(2) About like the Meston, for the paddy tracts and other areas where bullocks are small.

No. 1 would plough 6 or 7 inches deep and 8 or 9 inches wide and No. 2 about 4 or 5 inches deep and 5 or 6 inches wide, but the same body, offset and landslide, and point would suit both, the only difference being that No. 2 would require a narrower share and correspondingly narrower, though just as wide throwing, mouldboard.

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SILVICULTURE IN AUSTRALIA.

(BY N. W. JOLLY, B.A., B.SC., Dip. For.)

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Australia is a country of such large extent and with such a wide range of conditions that a paper on Silviculture might easily attain the size of a text-book—if sufficient were known of the subject ; but, as the progress of forestry has not yet resulted in the accumulation of extensive and detailed knowledge, the difficulty of discussing in comparatively few words the principal silvicultural characteristics of the indigenous forests is not as great as might be thought.

The wide range of climatic conditions gives rise to forests of numerous types from the sub-alpine to the tropical, plus, unfortunately, a superabundance of desert, but the predominant types throughout the heavily-wooded areas are those in which eucalypts form the main stand, and it is only to be expected that the members of the conference will have more interest in these than in any other.

The genus Eucalyptus, though disappointing and unsatisfactory in many respects from the silvicuture point of view, provides nevertheless, a range of species which renders possible the establishment of forests on the one hand at elevations of 5 000 feet n the Southern Highland, and, on the other hand, under a rainfall of 10 inches and shade temperatures exceeding 110

deg. F. in the neighbourhood of Kalgoorlie, a fact which entitles it to the respect of foresters even though they may abuse its failings in other directions. The drought-resisting qualities of many of the species and their evergreen habit render them particulary suitable to those parts of the Continent which suffer from periodical droughts and no definite seasonal rainfall, while the ability of other species at high altitude to resist sharp frosts in the middle of the growing season is a specially valuable characteristic.

Notwithstanding the special properties of numerous hardy species, the fact remains, however, that vigorous highly productive forests of first quality are only produced in those parts of the Continent in which the moisture conditions are specially favourable. Soil conditions also have an important influence on the development and distribution of different species in any one locality, and the genus definitely favours soils inclined to stiffness rather than those of a very light sandy nature, though, as is well shown on Fraser Island, with its rainfall of 60 inches and over, white sands with a mixture of humus produce very fine forests of two of the most exacting species, *E. pilularis* and *E. microcorys*.

Wherever it may be found, however, whether in moist or dry localities, the genus has one characteristic which, though it may vary in degree with different species, is strongly marked in all, *viz.*, it is essentially light-demanding. Two species, *E. microcorys* and *E. phellandra*, certainly bear a little shade, and have comparatively dense crowns, but, generally speaking, the foliage of the genus when in dense forest, not in open stand, is extremely light and open, the canopy being never dense enough to suppress the growth of grass, low scrub or a second storey. The fact that, both in the inland forests and in some of the coastal areas, underwood is lacking, is due not to the effect of canopy but rather to the strongly dessicating effect of the genus on the soil. It is this greedy absorption of moisture also which results in the underwood in the moist coastal forests being generally of a definitely xerophytic type, though in specially favourable localities, particularly in the cooler regions of Tasmania and the southern parts of the continent, a different type of underwood is found.

The admission of the sun's heat and drying winds through the open canopy and the soil dessication caused by the trees result generally in the absence of humus, in place of which one frequently finds hard, baked soil. Such dry conditions render the forests peculiarly liable to fire, which may rage through a eucalyptus area, whereas adjoining areas on which nature has developed a brush or scrub, as the rain forests are commonly called, are comparatively safe. The fiercest fires are experienced, not in the driest areas—which may be devoid of grass or underwood—but in the moister zones, where the xerophilous shrubs after developing vigorously in the growing period, become highly inflammable in the dry season.

That forests of eucalypts still abound in spite of their inflammability is due to the particularly hardy nature of most of the species and their wonderful power of recovery. A young seedling forest may be ravaged by fire, and yet twelve months later may be thoroughly green again with shoots from the ligno-tubers or bulbs, as they are commonly called, which are apparently nature's adaptation to ensure recovery from damage. In spite of the recuperative qualities of most of the species, very serious damage is, of course, caused to the form of the trees and to the quality of the timber through epicormic branches, wounds, and the access given to white ants, while a still more important effect possibly is the extremely adverse influence of fire on the composition of the forests, due to some of the more valuable species being less resistant than others of less value. For instance, *E. gigantea* in the highlands, and *E. microcorys* in the sub-tropical coastal zone, when in the young stage, are much less hardy than any of their associated species and suffer accordingly, with the result that they now exist in far less quantity than is desirable.

In other countries to which eucalypts have been introduced they are esteemed on account of their very high volume production, but, except in isolated cases, this has not been the experience in Australia, where, curiously enough, over a period of thirty years ***Pinus insignis*** gives a higher mean annual increment under a rainfall of 30 inches than do eucalypts under more favourable conditions. Possibly differences in soil and climate account for

the better returns obtained in other countries, but, in the writer's opinion, the reason is more likely to be found in the different methods of formation.

In Australia, with the exception of small plantations in South Australia, Eucalyptus forests result from natural reproduction, and an unfortunate characteristic of the genus is that reproduction is frequently extremely dense, much denser in fact than a wheat crop. For the first few years of their life such thickets may carry dense foliage and maintain excellent canopy, but, as soon as the adult leaf stage is reached, the light demanding characteristic asserts itself and the condition is entirely altered. Rapid height growth takes place, but the density of the stand does not admit of adequate crown development and the forest assumes the appearance of a dense array of inverted feather dusters, entirely lacking in vigour, the effect being so rapid that in the course of five years a healthy crop may change into an unhealthy and weedy crowd of spindles. What is perhaps more important still is that the stems so developed, having no rigidity, sway tremendously in the wind, the threshing of the crowns thus preventing one another's expansion—even if the stems were strong enough to carry larger heads. With planted forests, on the other hand, the wider spacing in early youth not only allows vigorous growth to be maintained for a much longer period, but results also in strong stems with robust crowns, capable of standing in denser stocking than swaying spindles with only a fraction of the head. It is not improbable that the susceptibility of the genus to the ill-effects of threshing is due in large measure to the brittleness of the young twigs, but the question is one which requires investigation if the main causes are to be ascertained.

In first-class localities there need be no fear of wider spacing resulting in badly-formed stems, for, with the exception of *E. microcorys* and *phellandra*, eucalypts clean their stems readily and can be relied upon to yield long clean timber if spaced as widely as 10 or 12 feet in the first year. An interesting result of the need of eucalypts for crown space, if their vigour is to be maintained, is the fact that much better canopy is obtained from a forest which is given the opportunity to develop freely than one

which is too densely stocked. In the greater part of Australia canopy in eucalypt forest is, at its best, so light and the humus production so small, that one is inclined to pay far less attention to this aspect than is necessary in cold temperate countries with their densely-crowned species, but if, in future, canopy is found to be all important, then this point is worthy of notice. Strong, well-developed stems can carry crowns which almost meet and interlock, whereas such a condition is seldom or never seen in those stands which have suffered from excessive density in youth.

In the best localities, therefore, where height growth is rapid and straightness of stem is almost certain to be obtained, the dense thickets resulting from natural reproduction require early thinnings, either heavy or repeated at short intervals, and these should be essentially crown rather than low thinnings. On the other hand, in the drier inland localities, the position is radically altered by the fact that insufficiency of moisture results in slow height growth and forked rather than straight stems, while with such a species as *E. rostrata* forking seems to be almost inherent. Under such conditions the maintenance of sufficient density in youth is of primary importance if a straight, though short, barrel is to be obtained, but thereafter crown thinnings must be practiced without delay, as the scarcity of moisture will not allow the growth of dense stands of older trees. If objection is taken at first sight to this idea, it should be remembered again that eucalypt forests are not conservers of soil moisture. Also if one refrains from discussing the commencement of thinnings from the stand-point of age, and concentrates more on height growth as the important factor determining when they should begin and how often they should be repeated, one may find that the difference between the treatment of the various types, or, for that matter, between eucalypts and broad-leaved species in other countries, is not as great as might appear at first sight.

That financial considerations must play an important part in silvicultural practice goes without saying, and, as in many places thinnings are not saleable below pole size in the case of durable species, and not below mill log size when the species are not durable, it is clear that the cost of tending can be kept within

reasonable bounds in the best localities only if the dense thickets of reproduction can be prevented from establishing themselves, or if markets can be found for the small material. It is for this reason that the possibility of developing the wood pulp industry in hardwood was the most important research problem brought under the notice of the Commonwealth Forest Products Laboratory. The mining industry, of course, offers the most satisfactory market for the sale of thinnings, but unfortunately, this industry can affect only a very small proportion of the State forests.

The question of underwood and soil improvement is one to which all visiting foresters very quickly turn their attention, but, as mentioned above, a typical underwood is not to be expected in dry localities, where, however, it is not uncommon to meet subsidiary species interspersed among an open stand of eucalypts—nature's indication perhaps that this is all that can be hoped for. In moist localities, however, an underwood of some form or another is the rule rather than the exception, but what part it plays in the life history of the forest has not been the subject of scientific investigation.

In the most favourable parts of Tasmania and Victoria, but much less frequently in other States, the underwood may be composed of moisture-loving species which result in humus formation and are reminiscent of the soil-improving underwood of the northern hemisphere, but more commonly it is distinctly xerophilous and composed of a low growth of Acacia, Leptospernum, Grevillea, Banksia, and a host of miscellaneous species, apparently of doubtful value. Where man has not interfered, however, the genus which stands out as the natural tree underwood is Casuarina, which, with its wiry branchlets and reduced leaf formation, is eminently suited to growth below the moisture absorbing eucalypts. This genus might, perhaps, be termed a comparative shade-bearer, though it is not this property so much as its xerophilous character which makes it the best of all indigenous species for the purpose. It is a matter of individual opinion whether it should be called a soil improving genus or not, and the fact that Forest Oak (*C. torulosa*) country in New South Wales

is considered to be good grazing land, after the oak has been destroyed, is probably due to the natural preference of that species for the better soils. However that may be, the most strikingly obvious reason for its occurrence is its great usefulness in reducing the severity of forest fires.

Any discussion on the comparative value of the various types of underwood to be seen in the eucalypt forests must take into account the condition of the forests when white men first took possession, and, though the oldest inhabitant is not always reliable, the same story is repeated from one end of Australia to the other, *viz.*, that, where now a horseman has to bore his way through the undergrowth, he used formerly to gallop after cattle through an open stand of big timber. In virgin forest dense sapling growth was of course not to be expected, and much of the change is due to utilisation and regeneration, but, apart from that, it is probable that the destruction of the Casuarina—originally of large dimensions—with a view to the improvement of grazing, coupled with the practice of frequent firing, is responsible for the intrusion of the miscellaneous undergrowth. That this latter is an unwelcome intrusion, not in any sense comparable with the Casuarina from a silvicultural, protective or æsthetic standpoint, appears to me undoubted. It is no less certain that the restoration of the genus to its natural position will be a long process, as, though hardly in the older stages, it is sensitive to fire as a seedling, while some species are readily grazed by stock.

Striking instances casting doubt on the value of moisture-loving species as underwood in some localities are to be seen in Queensland and occasionally in New South Wales, in regions of moderate rainfall—say 30 inches to 40 inches—where stands of eucalypts, frequently *E. paniculata*, adjoin the so-called pine scrubs, these latter being of the open rain forest type with large Araucaria as an overwood. Given protection from fire, these scrubs gradually extend into the adjoining eucalyptus areas, and not infrequently where this extension has taken place, the eucalypts show crown deterioration and incipient stag-headedness—presumably because the scrub growth, being of the moisture-loving type, reduces the amount of water formerly available to the

more deeply rooting species. A parallel case is recorded from South Africa, where the introduction of *Acacia decurrens* as an underwood to *E. globulus* resulted in the deterioration of the blue gum, while on the slopes of Mount Stromlo, at Canberra, the formation of plantations of *Pinus insignis*, under a very light overwood of eucalypts, is reported to be causing the death of the latter. Forestry in Australia has certainly to keep its attention focussed on moisture rather than on light.

The problem of mixed forests also will, no doubt, engage attention and cause discussion, but, as far as the natural association of eucalyptus species in Australia is concerned, there does not seem to be any question of a mixture of light demanding and shade bearing eucalypts—omitting, of course, consideration of the previous references to underwood. Some species, *e.g.*, *E. marginata, diversicolor, obliqua, pilularis, crebra*, &c., are frequently found in almost pure forest, but more often there is a mixture of two or more species without any apparent reason such as is generally associated with mixtures, *viz.*, canopy and soil improvement. In this connection, earlier plantations in South Australia used to call forth speculation, and, though the unsuitability of the localities for the production of good hardwood forests rendered discussion of doubtful value, nevertheless, the fact remained that where mixed species had been planted—either in single mixture or in lines—better crown development was observed than when species were planted pure. This might possibly have been due to the varying rates of height growth allowing crown formation at different levels, the stands at the time of observation being not sufficiently dense for one species to suppress the other, but it certainly was not a case of soil improvement.

One interesting mixture which calls for comment is that of Eucalyptus and Callitris, plus the ubiquitous Casuarina, in the inland forests of eastern Australia. The peculiar silvicultural value of this association is by no means clear, for the Callitris species are not soil improving in the accepted sense. Though they carry a comparatively dense crown in open formation, they are incapable of forming good canopy in dense stand, under which conditions they allow the free ingress of the sun's rays. At the same time

they are well adapted to, and apparently do not suffer unduly from, growth in close proximity to eucalypts, the light shade of which does not prevent the cypress sending its stem right through the crown. Perhaps the most probable explanation of the association is that the Callitris, having a much less dessicating effect on the soil and requiring less moisture for its existence than eucalypts is able to fill the spaces in the necessarily open stand of the latter and thus utilise some of the surplus light energy which they are unable to absorb. Whatever the explanation, the association is a valuable one economically, and, if the Callitris does not assist the eucalypts silviculturally, its reproduction is aided by the latter in that they prevent the unduly heavy growth of grass which would tend to reduce germination of Callitris seed and the survival of the seedlings. The association is in one respect, however, apparently disadvantageous to the eucalypts, for, whereas cypress reproduction has been comparatively prolific amongst the northern ironbarks, the latter have not reproduced freely, with the result that there has been a distinct change in composition in favour of Callitris. The very slow growth of this genus—more than one hundred years being apparently necessary to produce a tree of 10 inches diameter—makes such a change distinctly undesirable, and it is not unlikely that the use of fire will have to be called in to help maintain at low cost something approaching nature's original distribution of species.

Sufficient has been written to indicate that the all-important factor affecting the silviculture of eucalypts generally is moisture, and to no feature is this more applicable than to reproduction from seed. In passing, it may be mentioned that, with few exceptions, reproduction by coppice is generally vigorous, provided there is no suppression in dense thickets, though one notable species which has never been known to send out stool shoots except in the very young stage, is *E. gigantea.*

Compared with most other forest trees in Australia, the reproductive power of the genus from seed is strong; seed is light and readily dispersed by wind, though the large percentage of "chaff" in the seed vessels makes the crops less heavy than might

appear to be the case; germination is rapid in favourable seasons and seedlings comparatively hardy, though certainly subject to heavy loss through insolation; though species vary from frost-tender to frost-hardy, in those localities in which each species occurs naturally it is only by frosts that are exceptional for the situation that reproduction difficulties are caused; rate of growth in youth varies greatly throughout the genus, but in comparison with those of associated genera is generally fast—except that wattles are frequently more vigorous for the first few years and are liable to cause suppression.

The main difficulties of regeneration—apart, of course, from damage by grazing which in areas stocked with rabbits and sheep is very serious—are connected with climate and moisture, and whereas in the northern hemisphere the effect of light and shade is given most prominence, in Australlia it is not the shade cast by the parent trees, but rather the moisture which they absorb, which may be effective in preventing the establishment of the young crop, this being of special importance in the drier districts. It is for this reason that the time-honoured method of securing reproduction in our forests is to destroy, by ringbarking and felling, as much of the older timber and undergrowth as possible, and then to fire the area, thus making more moisture available, exposing the mineral soil and forming a good seed bed, and, at the same time eliminating temporarily the root and crown competition of weeds. In seasons when moisture is abundant, coincident with the occurrence of a seed year, and there is much less danger of the heavy mortality due to a dry soil, ample reproduction for the purpose is obtainable without recourse to wholesale ringbarking or, in many cases, even to firing; but the result is less spectacular, while the tending requires much more attention from the staff in that later selective ringbarking and freeing from weeds are essential if the young crops are to come through periods of dryness and establish themselves successfully.

In dealing with the application of silvicultural systems to the management of eucalyptus forests under existing conditions, it is necessary to grasp certain economic facts which exercise an

important influence on the present day possibilities and practice, for utilisation or the lack of it practically determines the procedure to be adopted. Of fundamental importance is the fact that the forests are frequently of mixed species, some of which are unsaleable, and, whether pure or mixed, contain so many unsaleable or over-mature trees that thorough utilisation is generally economically impossible ; also firewood, which forms not less than 50 per cent. of the volume of the forests, is more often than not a drug in the market. In addition, there has not been any general appreciation of the fact that the exploitation of the forests should be regulated by the requirements of silviculture and forest management, past practice having allowed the licensees or buyers to remove such trees or portions thereof as were marketable, the forest officer then following up, if he acted at all, with the regeneration of cut-over areas, either partially or wholly according to his understanding of the position.

In such circumstances, silvicultural systems could not enter into the question, and the only method practised was that entailing wholesale ringbarking, resulting frequently—but not by any means always—in dense stands of seedling growth, over the composition of which there was no control whatever where mixed forests of several species were being dealt with. This method, of course, tends to the production of even-aged crops composed of those species which happen to be seeding abundantly at the time, or which reproduce freely and show the most rapid growth in early youth. It entails expensive thinning later, and involves high protection costs over the long period which must elapse before saleable timber in any quantity is again available. One useful result of the method is the more effective destruction, by the fierce fires which are caused, of the large mass of debris which litters the ground, for, owing to the impossibility of disposing of firewood, the forests must otherwise be left in a very untidy condition. On the other hand, it necessitates delaying regenerative treatment till all saleable timber has been removed from a considerable area, a process which, as a result of the fastidious demands of the market and the roving habits of the operators frequently takes many years. Assuming, however, in future, that

utilisation is concentrated on smaller areas, that a greater percentage of successes is assured by closer attention to seed years, that the proportion of middle-sized growth is so small as to admit of the practice, and that the growth of even-aged forests is satisfactory, then the simplicity of the method makes its continuance, advisable where pure forests are concerned.

On the other hand, in the mixed forests, which are such a marked feature of the east coast, and in which the unbridled operations of two generations have resulted in an indefinite mixture of age classes and useless trees, the position is entirely different and has called for a drastic revision of procedure. In the first place, trade conditions do not allow the thorough utilisation of all species, and trees which are not marketable at one period may well be saleable ten years later and help to maintain industry, where a thicket of thinned saplings, though pleasing in appearance and increasing the increment, will not yield revenue or remunerative employment. Also the existence of younger age classes in all stages of growth renders some form of group system unavoidable, unless there is to be inordinate sacrifice of that part of the growing stock which should supply the needs of the next generation.

Still more important, perhaps, is the necessity for controlling the composition of the future crop, which cannot be properly regulated under what might be termed the "wholesale" method but which must have a vital influence on the future business of forestry. For example, the species contained in the mixed forests of the east coast of New South Wales may be divided roughly into two classes, the non-durable hardwoods, such as *E. pilularis, saligna, maculata*, &c., and the durable hardwoods, *E. microcorys, propinqua, paniculata* &c., and of these the fastest individual grower and the most prolific reproducer is *pilularis*, while the most valuable for all round purposes is *microcorys*. *Pilularis*, which is with difficulty saleable in any but mill log sizes, figures chiefly in the ordinary sawmill trade, from which comes a never-ending complaint of depression due to the competition of Oregon, whereas *microcorys* is eagerly sought for from the pole size upwards, and is always in demand for the best quality sawn produce.

Pilularis reproduces best under wholesale ringbarking, whereas *microcorys*, being more sensitive to isolation and frosts, and less light-demanding, can be regenerated successfully under light shelter. Also, although the growth of the latter species per individual tree is the slower, its demand for closer spacing if clean stems are to be obtained, and its capacity to carry a denser, more compact crown, make it possible that its volume production per acre may not be much below that of *pilularis*, while the financial returns should certainly be higher. (*N.B.*—Tables of volume production are still in the distant future.) Obviously, therefore, the practice of forestry in such forests requires the abandonment of the wholesale method and the introduction of a system which, though more expensive and difficult to manage, gives the forester a reasonable measure of control over the composition of the future crop, and, at the same time, renders less probable the establishment of the young growth in dense thickets.

The choice naturally lies between the compartment and the selection systems, but consideration of the former is frequently precluded at present because of the sacrifice of younger age classes which would be entailed, and, also because of the existence throughout of numbers of over-mature trees, the utilisation or destruction of which should not be spread over a whole rotation. The general condition of the forests, as well as the trade conditions, practically render it essential to adopt the selection system as the general method of treatment, selection being by single trees or groups, according to circumstances. The quantity of ill-grown or valueless growth on any area is generally sufficient to permit the openings made by the removal of single trees to be expanded, if necessary, so as to produce the same effect as the removal of a group of trees, but to what extent that is done depends upon moisture conditions and the peculiarities of the species in question. Taking important species from the east coast of New South Wales as examples, the largest openings are required by *E. pilularis* and *maculata* while *E. microcorys* is best favoured by small openings, and species such as *E. paniculata*, *corymbosa*, *propinqua*, &c., are intermediate in their requirements. Also the drier the climate and soil, the greater is the necessity for treatment by groups

rather than by single trees, but, as the practice of forestry is only in its infancy, accurate knowledge on the subject is not yet available, while the range of species and conditions is too wide for any attempt in this paper to deal with individual species.

In view of the lack of reliable data *re* rates of growth, and of information *re* the distribution of girth classes, the cutting cycle, if fixed at all, must be determined quite arbitrarily, but trade conditions do not allow rigidity and everything must be elastic. In fact, the present aim should possibly be to pay less attention to the cutting cycle and more to the control of cutting and the search for markets for inferior produce, so that utilisation will be complete enough to allow the economic practice of forestry. After all, the introduction of intense forest management under any system requires that the yield from the forest can be disposed of, but unfortunately, in the best forests, firewood—the material that should "pay the rent"—instead of being saleable, costs money to destroy. A discussion of silvicultural practice in Australia must give full recognition to this simple but very important fact.

Rain Forests.

The evergreen rain forests of the continent provide the only really typical examples Australia possesses of dense forests with uninterrupted forest canopy, from which the student can learn to appreciate all the advantageous effects of forests which are stressed in text books. Those of the tropical and sub-tropical climates are commonly called "scrubs" in Queensland and "brushes" in New South Wales, but apart from this type, there are also those of the colder but very wet climate, of the west and north west of Tasmania, in which the myrtle or beech, *Notofagus Cunninghamii*, is the dominant species, while the rare blackwood, *Acacia Melonoxylon*, and the conifers, Huon pine, *Dacrydium Franklinii* and Celery top, *Phyllocladus rhomboidalis*, yield especially valuable timbers. The silviculture of this latter class of rain forest has yet to be studied in a systematic manner, but notwithstanding the very great merit of the coniferous timbers mentioned, it seems almost certain that the slow growth of those species will exclude them from serious consideration in the future, so that they may be regarded as belonging to the list of vanishing species.

The blackwood, on the other hand possesses the common characteristic of the wattles of reproducing freely, especially after firing and of making rapid height growth in the first few years, qualities which, when associated with the excellence of its timber should ensure that it will be given adequate attention by the foresters of the future, while its partiality for low lying, wet lands, which can be rendered suitable for intense settlement only by the application of expensive drainage schemes, to some extent guarantees the retention of suitable areas under forest.

The *Notofagus* which is a most interesting species to plant geographers and others is frequently found both in mixture with the blackwood and in comparatively pure forest, the latter greatly predominating on the shallow soils of the rough, hilly country of the west, where the rainfall reaches 100 inches per year. It is a shade-giving species, the litter from which, owing to the abundance of moisture and the lack of great warmth, produces, an accumulation of peaty superficial soil in which its reproduction is established without exposure of the mineral soil, a characteristic which gives it a decided advantage over other species. This advantage is, however, somewhat discounted by its extreme sensitiveness to destruction by fire. It reproduces freely by coppice shoots but unsatisfactorily from a forestry standpoint, in that it sends up far too many shoots from the stump, this character being associated with the tendency of the stem to throw out numerous epicormic branches, which result in an unduly large percentage of trees with bad form and a low forest yield. The main problem of the future is apparently to decide whether this species is to be perpetuated, or conversion to conifers effected.

Special importance attaches to the areas under rain forest in the northern and warmer regions of the east coast of the continent which are the home of such excellent conifers as hoop and bunya (*Araucaria Cunninghamii* and *Bidwilli*), and the kauris (*Agathis robusta* and *Palmerstoni*) and of numbers of specially valuable broad-leaved species, amongst the best known of which are red cedar (*Cedrela australia*), white beech (*Gmelina Leichhardtii*), species of Flindersia and Dysoxylon, the proteaceous silky oaks, grevillea, Cardwellia, &c., and the black bean (*Castanospermum*

australe). The density and impenetrability of the forest vegetation in these warmer regions are generally not nearly as great as in the Tasmanian rain forests, though on the richest soils and in the heaviest rainfalls of North Queensland typically luxuriant tropical undergrowth is seen. More commonly, however, under rainfalls varying from 35 inches to 60 inches, with a comparatively dry winter, the forest cover and undergrowth are not specially dense, though sufficiently so to render them safe from fire. Rain forests are, in fact, the only natural forests in Australia which are comparatively immune from fire before exploitation.

These northern forests suffer from the failing peculiar to most jungles, *viz.*, a multiplicity of species, the percentage of the stand composed of species of high value being far too small. Moreover, the main stand of inferior timber trees also comprises so many species that the development of a trade in one kind of even low-grade timber has not been possible. For this reason, the silvicultural problem is in the first place greatly complicated by that of utilisation, the incompleteness of which results in additional expense in destroying the abundant unsaleable material. The use of fire, which in many cases can scarcely be avoided unless destruction costs are to increase enormously, immediately increases the difficulties arising from weeds, a prolific growth of which almost always follows the burning of the debris. The greatest troubles are caused, not by the tree weeds, but by such agricultural pests as the imported inkweed (*Phytolacca octandra*) and stinking rodger (*Tagetes glandulifera*) the spread of which has been much increased by the progress of dairying settlement and the use of bullocks in the forests for hauling purposes. One tree weed which is particularly difficult is the giant stinging tree (*Leportea gigas*), which apart from the dense canopy of its broad-leaved foliage, effectually prevents men from working amongst it. Weed troubles—both agricultural and forest—vary with the fertility of the soil and the annual rainfall, for the early growth of these pests is influenced thereby far more than is the initial growth of those species which are comparatively slow in youth. As a result the natural reproduction of hoop pine is more in evidence on the poorer and drier soils, being frequently absent in the more

fertile localities. Also the agricultural weeds give greater trouble on large burned areas used for artificial regeneration than on small patches involved in the adoption of natural systems.

Climatic difficulties associated with the distribution of rainfall throughout the year enter largely into the silvicultural problem, more so in connection with artificial than natural regeneration, for although a study of the average monthly rainfall over a period of years may appear to show a fairly even distribution or definite rainy seasons, in practice the annual planting season is always uncertain. Cool, moist winters are the exception, and hot dry springs are not uncommon, while favourable late summer and autumn rains may be followed by spells of hot dry weather, fatal to ordinary transplants. Consequently in artificial regeneration, recourse must frequently be had to the more expensive nursery work involved in the raising of plants in trays or tubes, the cost of which can, however, be offset to large extent by the adoption of wider spacing than is customary in plantation work, this being justified in those cases in which the valuable species cannot be raised in pure forest by the fact that the mixture of inferior species which come naturally in the course of a few years serves to maintain the cover and density necessary to the maintenance of soil fertility and the production of clean stems.

Of the two main sources of difficulty, *viz.*, weeds and planting season, the former has up to the present been the most serious economically, especially in the case of those species which are comparatively slow-growing in the first two or three years Fast-growing species, such as red cedar, can compete with weeds if given ordinary assistance, but hoop and kauri suffer to such an extent, if repeated costly cleanings are not effected, that attention has had to be directed to the time-honoured method of growing an agricultural crop, both to suppress weeds, more or less, and to offset cleaning costs. This practice has not yet been developed extensively, but the indications are that, in combination with the tube nursery system, it must be largely relied upon for the artificial regeneration of the valuable species of the rain forests.

The two serious economic difficulties abovementioned would be partly obviated if extensive utilisation of the subsidiary or less valuable species were possible and natural regeneration could be adopted. As regards utilisation, however, the world-wide experience holds good in Australia, namely, that the exhaustion of the more valuable is necessary to force the less valuable species on to the market, and then only if the prices of standardised supplies from overseas allow their use, which as yet is not the case. Natural reproduction has been shown to be possible to a limited extent in the case of such valuable trees as red cedar and species of Flindersia, and had silviculture been the subject of attention and forestry control been established when utilisation first commenced, natural reproduction of these broad-leaved species could have been obtained on a much larger scale. Uncontrolled exploitation had, however, so reduced the percentage of seed trees even a generation ago, that artificial regeneration cannot now be dispensed with if they are to form a satisfactory proportion of the new crop. Wind dispersion of the winged seeds—cedar being very light, but the Flindersias much heavier—results in the establishment of the young stand up to a radius of from 1 to 2 chains from the parent tree if the overhead cover of the surrounding brush is removed or partially interrupted. That this is generally only sufficient to stock a small fraction of an ordinary forest area is an indication of the very scattered distribution of the valuable species, which have been gradually giving way to the more aggressive of their associates.

Natural regeneration of the Kauris Bunya is greatly prejudiced by the fact that the cones fall whole, so that not only is the seed not widely dispersed—the Bunya at thirty to the pound weight is far too heavy in any case—but also it is readily attacked by rodents. The dispersal of Hoop seed, on the other hand, is much more effective, and results at lengthy intervals of comparatively abundant reproduction which, however, is unable to thrive under the shade of, or in competition with, the established underwood. As Hoop seed is frequently of a low germinative capacity and grows chiefly in regions where the seasonal rainfall is unreliable, natural reproduction, which is dependent largely on the

coincidence of a favourable seed year with a favourable season, cannot be relied upon as the mainstay of regular and systematic forestry practice. In fact, it seems certain that reliance must be placed largely upon the artificial regeneration of all valuable species without exception if they are to form a sufficiently large percentage of the stand to make the forests highly productive Natural reproduction of the subsidiary species is generally attainable, and perpetuation of the forests is assured so far as they are concerned, but as they have no special merit as timber producers when in competition with the cheap supplies of imported softwoods, there seems to be no object in concentrating attempts at forest management upon them. It seems, in fact, to the writer that, if the economic difficulties in the way of raising the high-grade species are excessive, conversion into fast-growing exotic conifers is preferable to con-centrating on nondescript species. Experimental work in this latter direction points to *Pinus luchuensis* and *insularis* as offering possibilities which cannot be ignored, and to those who would urge that Australia should always give preference to her own indigenous species, pointed reference is made to the unsatisfactory condition of the local saw-milling trade in several States and the continued increase in imports, notwithstanding the imposition of extraordinarily heavy tariff duties to protect the local forestry industry. Australian silviculture should concentrate primarily upon the growth of durable hardwoods for special purposes, and of the "bread and butter" softwoods which constitute the bulk of the world's requirements, and which cannot be replaced satisfactorily by the miscellaneous species characteristic of rain forests.

PULP AND PAPER IN AUSTRALIA.

(BY L. R. BENJAMIN*.)

[*Paper prepared for Third British Empire Forestry Conference.*]

It is a striking fact that, although the population of Australia is about two-thirds that of Canada, and the consumption of paper

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per head is about the same in both countries, no wood-pulp or newsprint paper has been made commercially in Australia up to the present, whereas Canada leads the world in this respect. The reason for this is perfectly clear. In Canada the forests are comprised very largely of conifers, whereas the forests of Australia consist for the most part of broad-leaved trees; the former (spruces, firs and pines) have been the main raw materials of the wood-pulping industry for fifty years, the materials indeed upon which the industry was founded and upon which it has developed to its present gigantic dimensions, whereas there has been comparatively slight utilisation of the broad-leaved woods and none at all of the genus eucalyptus which is peculiar to Australia and forms our major forests.

But the very fact that the pulping industry was expanding so rapidly abroad and the cost of pulpwood increasing by leaps and bounds, led to the belief, some ten years ago, that if the eucalypts were systematically investigated with a view to developing suitable methods of pulping them it might be economically feasible to establish the pulping industry in this country too.

As the sulphite pulp and newsprint industry now seems in a fair way to becoming established in Australia, a brief outline of the history and the scope of the investigations which have led up to this position may be of interest.

Historical.

The first recorded investigation of the pulping properties of Australian woods was carried out in 1915 by the late H. E. Surface, of the Forests Products Laboratory, Madison, Wis., U.S.A., for the Tasmanian Government. This work was done at Hobart, Tasmania. Mr. Surface experimented with the soda process only, using the general procedure employed at that time for making soda pulp from broad-leaved woods in the United States. He reported unfavourably on the applicability of the soda process, and assumed that as the sulphite process is not generally used for hardwoods elsewhere it would most likely be less suitable than the soda process for the eucalypts examined by him, *viz.*, *E. regnans* (swamp gum) and *E. obliqua* (stringybark). For a similar reason he did not make mechanical pulping tests.

In 1917, when a shortage of paper due to the war appeared possible, a committee was formed in Melbourne to ascertain the possibilities of making pulp from Victorian woods. The committee had a quantity of mountain ash (*E. regnans*) and woollybutt (*E. delegatenis*) sent to a mill in Norway for testing purposes. The report was distinctly unfavourable. In the same year, 1917, a committee was formed in Sydney, New South Wales, for a similar purpose, but it decided to make semi-commercial tests locally. Though it is known that a plant was built during the next year or two, this committee never published a report on its pulping tests, and no record of its investigation appears to be extant. Thus three States made efforts to ascertain the possibilities, each in a different way, but with no apparent success.

Meantime the Commonwealth Government had set up an Advisory Council of Science and Industry to advise it on ways and means of meeting emergencies arising from the war, and on other matters of national importance concerning the application of science to industry. In each State a committee was formed to deal with local problems, and as a result of this organisation, a sub-committee was formed in Western Australia to deal with the question of the more efficient utilization of forest products. Thus there began, in 1918, an investigation into the pulping of immature wood (thinnings), and mill-waste from the Karri (*E. diversicolor*) and Jarrah (*E. marginata*) forests of that State. This preliminary work was confined to small scale tests, using the soda process. The results obtained were so different from those reported by H. E. Surface, that a plan was formulated by this committee to extend the scope of the work to the principal eucalypts of the other States. The idea of establishing a national forests products laboratory had, for some time, been exercising the minds of a number of men interested in the conservation and regeneration of the eucalypt forests. The encouraging results of this new work afforded strong support for the scheme to establish such a laboratory, and, due very largely to the vigorous efforts and enthusiasm of the Western Australian sub-committee, a Forests Products Laboratory was established at Perth in 1919, under the newly-established Bureau of Science and Industry.

Systematic investigation of the pulping properties of the principal woods available for pulping throughout Australia was commenced in April, 1919, in co-operation with forest authorities of the various States, and the projects then laid down, whereby each pulping process was to be carefully investigated as regards its applicability to these woods, have been followed without serious interruption and gradually completed. The Forests Products Laboratory, as such, unfortunately did not survive beyond 1922, but the impetus already imparted to the paper pulp investigations by the enthusiasm of the first director of the Forests Products Laboratory (I. H. Boas, M.Sc.), and the cordial support accorded by the press and public of Western Australia, coupled with the initiative and team work of the technical staff, were sufficient not only to carry forward the early plans but to elaborate them, and, despite criticism at home and abroad, which often amounted to derision, finally to demonstrate the entire technical feasibility of making many grades of paper, including newsprint, solely from the eucalypts. Actually, the accomplishment of this task took almost precisely ten years from the time the first laboratory tests were made on *E. diversicolor* in Western Australia by the soda process, to the successful conversion into newsprint of a mixture of *Eucalyptus obliqua* sulphite pulp and *Eucalyptus regnans* mechanical pulp on a paper machine in the south of Tasmania this year. Thus a decade of painstaking research has been necessary to overcome the effect of early adverse reports on the suitability of our own woods for pulping, and to wear down the conservatism of the paper industry, so notorious the world over. And, in this last respect, it is well worth noting that those financially responsible for the present programme of development in Tasmania had no previous experience in the paper industry, though they have to their credit the founding of some of the largest and most highly technical industries in the Commonwealth.

Paper Requirements of Australia.

That there is plenty of scope for the development of the pulp and paper industry in Australia is evident from the statistics of consumption and production of paper in this country.

As stated already, no wood pulp, either chemical or mechanical, has hitherto been made in Australia.

The greater part of the paper-board and straw-board requirements of the country, amounting to some 25,000 tons a year, are manufactured in up-to-date mills in Sydney and Melbourne. Some Swedish sulphite pulp and groundwood, and much waste paper is used in this branch of the industry. Less than half the kraft paper used in the Commonwealth is made at present, chiefly in Sydney from Swedish pulp, the remainder, about 10,000 tons a year, is imported in the roll and in sheets, mostly from Canada and Scandinavia. There is a duty of £8 a ton on this class of paper. Recent installation of new plant has, however, nearly doubled the capacity of the local kraft mills. Of printing papers other than newsprint, 25,000 tons is imported annually, principally from Great Britain. Something less than 1,000 tons per annum is made in the Australian mill. A duty of £3 per ton operates against printing paper of foreign origin, while that from Empire countries enters free of duty. No statistics are available relative to quantities of writing, typing, and similar papers, but an estimate based on the value recorded against imports of this class indicates about 6,000 to 7,000 tons a year, Very little of this class of paper is made locally. Finally, no newsprint whatever is made in the Commonwealth. That this offers one of the most attractive avenues of development of the paper industry is shown by the annual consumption of 120,000 tons worth over £2,000,000. At the present time, 60 per cent. to 70 per cent, of this is English origin and the remainder principally Canadian, though about 8 per cent. of Scandinavian paper still comes in, despite a £3 duty against it. Canada has attained the present position only in the past three years, as a result of the enactment of the Reciprocal Trade Agreement of 1925. In 1924, very little Canadian paper entered Australia, being subject then to the same duty as paper of foreign origin.

Summary of Investigations of Commonwealth Government.

1. *Critical study of the Variable Factors involved in the Preparation of Soda Pulp from Eucalypts.*

The results of this work, which was first carried out on a laboratory scale, and then semi-commercially in an Australian Paper Mill, showed that a high yield of easily bleached pulp could be made by cooking for a relatively short period with alkali of low concentration. This class of pulp, which, despite the shortness of the fibre, possesses considerable strength, proved to be well adapted to the making of fine printing papers.*

2. *Comparative Cooking Tests by the Sulphate (or Kraft) Process.*

The results of these tests showed no material improvement over those obtained by the specially-developed soda process for making easy-bleaching pulp. It should be noted that eucalyptus kraft pulp, owing to the shortness of the fibre, cannot be used by itself in making kraft paper. It was found, however, that 20 per cent. to 25 per cent. could be advantageously used with longer fibred (coniferous) kraft pulp, especially in medium to heavy-weight papers.

Sulphite Pulp.—A comprehensive study of the applicability of the sulphite process to the pulping of the eucalyptus was commenced early in 1924, and continued without interruption for more than three years.† The principal object of this investigation was to ascertain the condition under which sulphite pulp of a quality suitable for the manufacture of newsprint could be made. The previous work on soda pulp had proved the eucalypt fibre to be inherently strong, despite its shortness, and the indications obtained were that if it could be pulped sufficiently cheaply it it could probably be used alone in making newsprint.

Both laboratory tests and full-scale sulphite pulping trials were made during this investigation and it was finally proved beyond reasonable doubt that a very high yield of pulp, white enough for use without bleaching, and eminently suitable for

* For details see Bulletin 25, Commonwealth Institute of Science and Industry, Melbourne, 1923: "The Manufacture of Pulp and Paper from Australian Woods," by L. R. Benjamin.

† See Bulletin 36, Commonwealth Council for Scientific and Industrial Research, Melbourne 1928: "Paper and Cellulose from the Eucalypts by the Sulphite Process," by L. R. Benjamin and J. L. Somerville.

direct conversion into newsprint, could be produced from three or four of the most abundant species of eucalyptus. Important savings in production costs were indicated by the results of these investigations, *e.g.*, the cooking time, compared with the regular practice in making news-grade pulp in Canada and Scandinavia, was almost halved, and as the woods cooked are 50 per cent. denser than spruce and the yield per unit weight of wood at least 20 per cent. in excess of that from spruce, the potential output per unit of digester capacity is more than trebled. This, of course, means less labour per ton, and less fuel, as well as appreciably lower capital charges.

As an outcome of this work and an economic survey of the conditions under which the industry would operate, it appeared that newsprint could probably be made entirely from eucalyptus sulphite pulp on a commercial basis. That the paper could actually be made from this pulp was, of course, proved on a laboratory scale. Its strength was in fact very much higher than that specified for standard newsprint, and this at once suggested the possibility of still further reducing the cost of producing newsprint by filling with a cheaper pulp such as groundwood.

4. *Groundwood or Mechanical Pulp.*—This work was taken up as a corollary to that on sulphite pulp. It was clear from the earliest preliminary experiments that the general basis of newsprint manufacture from softwoods, *viz.*, 70 per cent. to 80 per cent. groundwood, and 30 per cent. to 20 per cent. sulphite, would be impracticable in the case of the eucalypts. Work was, therefore, confined to ascertaining the species that could be used for the purpose indicated above and finding the best conditions of grinding them.

The result of this programme was the selection of a few outstanding species for making mechanical pulp. It was found that one of these, namely, the immature (6 in.—15 in. diameter), normally twelve to twenty-five years old wood of *Eucalyptus regnans* stood out above all the others; it ground as readily as spruce, gave a whiter pulp, and apart from acting as a filler, possessed certain desirable paper-making qualities. The extent

to which this groundwood could be used with eucalyptus sulphite pulp in making newsprint of standard strength specification was found to be 30 per cent. to 35 per cent.* Thus the groundwood-sluphite composition of newsprint made from the eucalypts would be the reverse of the regular composition of softwood newsprint. The economics of this basis of newsprint manufacture appeared to be sound, and the announcement of the results of the investigations led to the formation of a company to develop the industry along the lines suggested. The "pilot" pulp and paper-mill of this company has now been in operation for several months, and has proved the complete technical feasibility of making paper of newsprint quality from eucalyptus wood. Further developments now pending are being watched with interest throughout Australia as well as in Canada and Great Britian.

Distribution of Pulpwood Species in Australia.

The principal belts of country forested with the species most suitable for pulping occur in the south-east of the Continent. Of the upland and mountain types *E. regnans* is the best pulpwood, and next to this are the species often associated with it, *e.g.*, *E. obliqua*, *E. delegatensis*, and *E. globulus* (immature); all of these make satisfactory sulphite pulp, but only one of them (*E. regnans*) makes good groundwood. Then come the harder eucalypts, such as *E. pilularis* and *E. maculata*, grown under warmer climatic conditions in New South Wales and suitable rather for soda pulp than sulphite. All these woods are light coloured when young, the harder types becoming tawny coloured at maturity. Lastly come the red-coloured eucalypts such as *E. diversicolor* (Karri) of Western Australia. similar to *E. regnans* in most of its properties but too red in colour to make sulphite or groundwood, even when young, and other red-tinted woods not nearly so suitable for pulping even by the soda process.

Thus the pulpwoods most suitable for sulphite and groundwood are found in Tasmania and Victoria and good material

* Bulletin 35, Council for Scientific and Industrial Research, Melbourne, 1928, "Kraft Pulp and Paper from *P. insignis*," by L. R. Benjamin, J. I. Somerville, R. B. Jeffreys, and W. E. Cohen.

for soda pulp occurs in the eucalypt forests of northern New South Wales and the south-east of Western Australia. South Australia possesses no indigenous pulpwood forests of any commercial value, and the more important forests of Queensland are of a type that do not contain a high proportion of the eucalypts. These "brushwood" or "scrub" forests, as they are locally called, contain species best suited for conversion by the sulphate process into a brown pulp that may be used in making kraft paper when mixed with some longer fibred pulp.

The sulphite pulp and newsprint industries of the future are, therefore, likely to grow up in Tasmania and Victoria, and possibly soda pulp mills will later on be established in New South Wales and Western Australia. At the present time Tasmania seems to afford the best opportunity for successfully establishing the newsprint industry, as it possesses abundant potential water power for the purpose, relatively cheap wood and species that regenerate easily and prolifically.

Exotic Conifers.

This paper would not be complete without brief reference to the role that the silviculture of exotic pines in Australia and New Zealand is likely to play in the future pulp and paper industry of the Commonwealth.

Investigations made by the Commonwealth Council for Scientific and Industrial Research have demonstrated on a mill scale the feasibility of producing first-class kraft paper from the most important exotic conifer planted in Australia and in New Zealand, namely *Pinus insignis* (Monterey Pine),† In has been proved in the laboratory too that this wood can be converted into sulphite pulp of high quality by suitable adjustment of cooking conditions. The resin content of this pine is no higher than that of white spruce, a fact which places it on a plane much above the other pines as a pulpwood for the chemical processes, and it is not too much to expect that this wood can also be converted into a satisfactory mechanical pulp.

† See Bulletin 31, Council for Scientific and Industrial Research, Melbourne 1927; "Newsprint Grinding of Immature Eucalypts for Mechanical Pulp, &c.," by L. R. Benjamin.

Foresters attending this Conference will no doubt have the opportunity of witnessing the very extensive planting operations that are in progress in Australia and more particularly in New Zealand, where some 50,000 acres are being stocked per annum, principally with this pine; and, as they will also see plantations in both countries fit for cutting as pulpwood when 15 to 16 years of age and carrying 25 to 35 cords of wood in the bark, some idea will be gained of the enormous possibilities for the production of pulp and the influence these plantations are likely to have upon the development of the pulp and paper industry in Australia and New Zealand. In the pumice lands of New Zealand, for instance, cost of formation is so low and the land so worthless for other purposes that, taking all interest charges into consideration, pulpwood could be grown for very little more per cord than the stumpage now being paid for spruce pulpwood in Canada. As these extensive pumice lands are very well-watered and potential water-power developments are abundant the growing of pine pulpwood will most probably become an attractive proposition. It is indeed well within the bounds of probability that less than twenty years hence large quantities of pulp, if not paper, will be exported from this region. Although Australia does not posses such extensive potential pinegrowing territory as this, there is available in the south-east of South Australia an area capable of growing quantities of pine pulpwood sufficient for Australian requirements of long-fibred chemical pulp for a considerable time to come, and while there are no important streams in this area it is nevertheless very well supplied with ground water and there is an abundance of one of the principal raw materials required by the industry—limestone. There can be little doubt that if the planting programme now in progress in this part of Australia is steadily followed out an important source of long-fibred pulp will be available to the paper industry.

CONCLUSION.

To summarise the results of investigations carried out in the past ten years, it can be confidently stated that the methods developed for pulping the eucalypts, and the economic feasibility of growing pine for pulpwood on a short rotation, leave little

room for doubt as to the feasibility of Australia becoming entirely self-supporting in regard to its newsprint requirements within the next ten years, and for most other grades of paper inside twenty years.

THE COWDUNG PROBLEM—A SOLUTION.

1. The progressive deterioration of agricultural lands in India is closely associated with the callousness of the Indian cultivator with which he exhausts his fields year after year without ever giving a thought to the need of manuring them. Not even the most fertile lands can bear the strain of *yielding* annual crops without some sort of replacement of nutrient materials in the shape of manure. It is, therefore, not surprising that the agricultural produce in India has suffered both in quality and quantity; and poverty continues to afflict the masses inspite of the continuous increase in lands brought under the plough. During and before the eighteenth century, the unrest in the country sufficed to give at least some rest to agricultural lands, which remained uncultivated for long periods during internecine wars. With the advent of British rule in India and consequent peace, the agricultural lands have been constinuously cultivated without any resting period, unless it is enforced by a *famine*—a calamity not without its own advantages.

2. The poverty of the cultivators alone rules out the possibility of introducing chemical manures on the Indian fields. The foreign manure propaganda with its manifold ramifications has not yet made any headway in the villages and as a matter of fact is foredoomed to failure. Imported manures can never be cheaper than cowdung which has been proved to be as good as chemical manures on agricultural farms. The Indian villager cannot even afford to use cowdung, of which he has a plentiful supply, as manure on his fields. For want of any other fuel, on these treeless plains, he is forced to use cowdung as fuel rather than manure. The problem thus resolves itself to the supply of fuel to the cultivators in order to save a valuable manure from being burnt for the amelioration of agricultural lands. The cultivator, however, gets his cowdung cakes for nothing. The

women folk collect it in their idle hours and make cakes with it. The villager will obviously, therefore, refuse to buy fuel at any price however low, unless he gets it as cheap as his cowdung cakes, that is for nothing. Situated as the forests in these provinces are on the outer fringes of the Himalayas, the transport alone would render the supply of fuel, from its only source *viz.*, forests, impossible owing to prohibitive costs. It is obviously impossible to ensure a sustained supply of free fuel from the forests to the cultivators living in villages dotted all over the Gangetic Plain. And even if the State were to subsidize the free distribution of fuel in the interest of agriculture, the source of supply would be exhausted sooner than what is popularly believed.

3. Beyond expressing a pious hope that this state of affairs will cease, the Royal Agricultural Commission have failed to give a definite lead to the country on this vital question. They have merely contented themselves by stating that the problem exists, without attempting to offer a solution.

4. To my mind, the cultivator has no other alternative but to grow his own fuel. Every village must have its own fuel plantation which could be successfully raised if the villager only knew how easy it is to do it. There are always some lands near every village which are allowed to lie fallow owing to their being unfit for agricultural purposes. Such lands can be easily utilized for the production of fuel and fodder grass. If necessary, fields of low productivity could be also set apart for this purpose. Both the zamindar and the cultivator will give up such lands for the production of fuel, provided no revenue is assessed on them by the Government. It is here, that the Government can help the agriculture and encourage the establishment of fuel plantations by making them revenue free.

5. The cultivators will supply the labour for raising the village plantation in return of which they will get free land to cultivate in between the rows of trees, fodder for their cattle and in time to come free fuel. The fuel plantation should be raised on the *taungya* basis which would cost nothing to the zamindar. It will be jealously guarded by the cultivators and

will be well looked after along with their field crops. Having obtained a plentiful supply of free fuel, the zamindar can prohibit the use of cowdung as fuel and enforce the cultivators to use it as manure. A single crop on a manured field would be enough to make the cultivator realize the value of his cowdung. He would soon wake up to the fact that his cowdung as manure brings him more money in the shape of increased yield from his field, than what he saves in fuel if he burns it. He would sooner buy his fuel than burn his valuable manure; and cowdung cakes will disappear from the Indian hearths as they did in England over a hundred years ago.

6. A single convincing demonstration of such a fuel plantation will catch the imagination of both the zamindars and cultivators; and soon fuel and fodder reserves will form a permanent feature of the Indian village economy. Quite apart from supplying fuel, fodder, and timber for agricultural implements and house building, and releasing valuable manure for ameliorating agricultural lands, such plantations dotted all over the country-side will ensure healthy environments, increase the rainfall, and relieve the monotony of the Indian plains. The Forest Department cannot do better than to co-operate actively with the zamindars in the establishment of such plantations near the villages. The U. P. Forest Department have already taken steps to interest the zamindars in village plantations. A start was made in the districts of Budaun and Bijnor last year and inspite of the failure of monsoons encouraging results were obtained in the demonstration areas. That the zamindars are not slow to appreciate the benefits which are likely to accrue from these plantations, would be apparant from the numerous enquiries made by them on the subject, while some of them have already undertaken to afforest small areas as an experimental measure at their own expense. The idea is already proving infectious and is bound to spread provided the feasibility of this scheme can be successfully demonstrated in various districts.

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PRIVATE ESTATE FORESTS OF CHOTA NAGPUR, BIHAR AND ORISSA.

The "Indian Forester" of July last published a note by Mr. B. P. Basu, I.F.S., on "The Destruction of Forests in Chota Nagpur". To this article the Honorary Editor added a footnote to the effect that to put a stop to the destruction of the forests a better remedy than forestry propaganda among the people would be a law requiring owners of private forests of more than a certain acreage to employ a professionally trained Forest Officer and to manage their forests under working plans sanctioned by Government. Unfortunately it seems that any attempt at special legislation is impracticable. Prior to the formation of this province the denudation of forests in Chota Nagpur engaged the attention of the Government of Bengal who prepared a bill for the purpose of enabling Government to assume the management of private forests. The provisions of the bill were thought too drastic and there was such great opposition to it that it was abandoned. In 1925 a revised bill for private forests was prepared but in the absence of non-official support it was not even introduced in the Legislative Council as its defeat would have been inevitable. There is no doubt that in the present state of public opinion there can be no satisfactory check to the rapid destruction of private forests, and the question arises what is the utmost that can be done without special legislation.

I have seen it stated that the primary cause of the existing state of affairs is the encouragement to the deforestation of private forests given by the Chota Nagpur Tenancy Act. I have not read this Act but I have seen extracts of the first Ranchi Settlement Report, upon which subsequent settlement reports of all Chota Nagpur districts have been based, and there is no doubt that the impetus to deforestation has been caused by the manner in which the rights of the *raiyats* in respect of forests was recorded. Though these records vary slightly they are much the same all over Chota Nagpur and generally the only restrictions placed on the *raiyats* are that they cannot fell trees except for buildings, for repairing houses, for agricultural purposes, or for fuel, that they are not allowed to fell trees for sale, and that they cannot cut sal

trees over 27″ in girth. These restrictions are in practice quite useless, especially as the *raiyats* do not require the landlord's permission before carrying out any felling. There is no restriction as to quantity and no provision against wanton damage or destruction. The position is that the landlords and tenants possess joint interests in the forest. The landlord's absolute right to exploit the forest as he pleases is not restricted in any way. The Settlement Officer was an optimist when he expected that the landlord and his tenants would respect each others' rights. The result has been disastrous. Landlords have sold their jungles to contractors and the contractors naturally take everything they want which the *raiyats* do not succeed in cutting first. It has developed into a race between the landlord and his tenants.

Subsequent to the abandonment of the Private Forest Bill drafted by the Bengal Government the question of the denudation of the forests was next taken up seriously in 1916. The outcome was in the main a campaign to persuade private forest owners to apply under section 38 of the Forest Act. At the same time managers of wards and encumbered estates were definitely instructed to apply under this section for forests in their charges. At the suggestion of the Conservator of Forests a formal agreement had to be entered into in regard to forests of which Government did not assume direct management. The proprietor had to agree that the forests should be managed under the prescriptions of a working plan sanctioned by Government. In the event of failure to observe the agreement Government could either acquire the forests by purchase or assume direct management. No success was attained by this campaign. Many applications were submitted by managers of wards and encumbered estates but only one or two by actual proprietors. As soon as encumbered estates were released from management the proprietors no longer desired the enforced protection of their forests.

This state of affairs existed till 1926 when Government was roused into forming a scheme whereby the forests which it was most necessary to protect should be acquired gradually, certain sums of money to be provided annually for their purchase. The

project met its fate the same year in the Legislative Council and was forthwith abandoned.

Although acquisition would go a long way in ensuring supplies of timber and fuel in areas where a shortage is imminent, the cost works out so high (the estimate for the area chosen in 1926 was over Rs. 20 an acre) that in the present financial state of the province the small area that could be brought under the Forest Department by this means would not go very far in lessening the danger from floods arising by the denudation of catchment areas in Chota Nagpur. In the absence of special legislation, of which there seems no prospect, there is nothing left to help to save the situation now except active propaganda work. Mr. Basu advocated this so as "to create a forestry 'sense' among the people". It is, however, the landlords we want to get at. We want them to apply under section 38 of the Act for the reservation of their forests and to make the procedure and the result of this as attractive as possible.

Before 1926 it was considered inevitable that to reserve a forest the Forest Settlement Officer should take action to extinguish rights of user. This either meant that the rights had to be extinguished by paying compensation, an expenditure which proprietors were unwilling to bear, or that sufficient forest had to be set aside in which the *raiyats* could continue their rights. The latter could not be done satisfactorily, because the inroads of cultivation have already made blocks of such a size that any further diminution would render them too scattered and small for demarcation and management.

A different procedure is now being adopted, more acceptable to the landlords and the *raiyats*. An inspection and report is first made by the Forest Department. The inspecting officer calculates if the forest is capable under systematic working of meeting the requirements of right-holders and yet of leaving a surplus annually for disposal to the benefit of the proprietor and to defray the costs of management. In most cases forests of a reasonable size have been found capable of doing so. They are then reserved with the rights of the *raiyats* limited and under control, and the proprietor enters into an agreement for the

management of his forests in accordance with a working plan sanctioned by Government. At his option the forests may be managed directly by the Forest Department or by his own agency under the supervision of the Forest Department. Applications for forests which have already been reduced too far in size and condition, and which are incapable of even meeting the requirements of right-holders, are rejected, otherwise they would be a perpetual financial burden to the proprietors.

The Forest Department is now undertaking the demarcation of all newly reserved forests, the only cost to the proprietors being the actual cooly labour. So far we have been able to carry out the demarcation at approximately Rs. 7/8/- a mile of artificial boundary. Our policy is firstly to control the rights of the *raiyats*, for which there is no provision in the settlement records, and secondly to bring in as large an annual income to the proprietor as is consistent with systematic management. The *raiyats* are satisfied as they get their legitimate requirements and will do so in perpetuity. The landlord besides getting a steady income has the satisfaction of seeing that his forests are no longer unreasonably cut down by his tenants in an abuse of their rights, while a firm hand is kept on the pilferage and illicit sale which has gone on for so many past years.

The owners of all private forests are invited to ask for an inspection report by the Forest Department. This initial report will cost them nothing nor will it bind them in any way. The number of applications made recently in the Ranchi District has been most encouraging and it is hoped that the work now being carried out for the management of these forests will induce many more proprietors to come in.

F. A. A. HART, I.F.S.

Dated 12th February 1929.

THE UNIFORM COMPARTMENT SYSTEM IN THE YINKE RESERVE, BURMA.

A few remarks on the problems confronting the regeneration of *in* (*Dipterocarpus tuberculatus*) in the Yinke Reserve, Katha Division, may be of interest.

Description. The Reserve of 67,127 acres is situated on flat featureless ground to the east of the Irrawaddy river in Upper Burma. The soil is deep alluvial, the hot weather water-level being as low as about 160', necessitating tube wells at forest bungalows. The rainfall is about 58". There is a narrow belt of mixed forest, about half a mile wide on sloping ground just above the Irrawaddy flood level, inside which the forest consists largely of pure *in* with a slight admixture of trees such as *thitya* (*Shorea obtusa*) *tamalan* (*Dalbergia Oliveri*) *thitsi* (*Melanorrhœa* sp.) etc.

In the less sandy parts, *ingyin* (*Pentacme suavis*) which is a far more valuable species, predominates. The outer compartments have all been heavily worked for *in* timber for many years prior to reservation. The result is a mass of *in* pole regeneration, wherever sufficient gaps have been made, this regeneration covering most of these compartments. In effect, village and trade fellings of past years have here been in the nature of heavy seeding fellings and it was obvious that dense *in* regeneration would come up in massed groups wherever gaps are large enough.

Method of working.—The method of treatment is the uniform system, aiming at the conversion of irregular to uniform high forest. The reserve is divided into square demarcated compartments of 1 sq. mile each.

The Working Plan fixes a tentative rotation of 120 years divided into 6 periods of 20 years each. The outer compartments referred to above are grouped into a *Post Regeneration Block* in which the object is to do the best possible for existing regeneration, by removing by sale marketable overwood species and the remainder by subsidiary operations. At the same time, all compact groups of trees 6' and under are left to carry on to the end of the rotation.

The most accessible of the untouched forests, to a total of approximately 1/6th of the working circle, are allotted to the *regeneration block* in which regeneration is to be completed within 20 years. The Plan indicates primary, intermediate and final fellings, though details are left to be decided as the result of experience.

FIG. 1.—Regeneration fellings. Marking for seeding felling, Compt. 11, Sub-Compt. 12. Seed bearers ringed with tar.

Photos by A. Long.

FIG. 2.—Post Regeneration Block Compt. 18 Type of forest before any extraction or operations have commenced. Note : *In* advance growth in the foreground, and Forest School students.

FIG. 3.—Post-Regeneration Block. Compt. 41. Type of forest after extraction by traders completed, but before subsidiary operations commence. Scattered trees left over regeneration.

Photos by A. Long.

FIG. 4.—Post-Regeneration Block. Compt. 41. Type of forest after completion of extraction and of subsidiary operations (improvement fellings and thinnings etc.). On right, note established regeneration freed of over-head cover and on left note a compact group of trees 6′ and under left over to the end of the rotation.

The Block next to be regenerated is allotted as Block II in which a cycle of Improvement Fellings are prescribed; these fellings aim at inducing regeneration of the main species in places where seedlings are absent, in order to simplify subsequent regeneration fellings.

The remainder of the area is unallotted and covered by the usual cycle of selection fellings of mature and unsound trees.

The unit of working.—It has already been found out that compartments of a square mile each are too large as units to be dealt with by proper silvicultural methods. There is over-lapping of compartments between Blocks, with the result that areas have been treated by wrong methods, although prescribed by letter. Each compartment is now sub-divided into 16 sub-compartments of 40 acres each and it has been decided to classify each sub-compartment into its proper block before operations commence. This classification was done this year, by eye, by a gazetted assistant which method is possibly more valuable than a stock-map prepared by a Ranger. This will separate the compactness of the Blocks and tend towards a floating regeneration Block. Although periodic revisions of Block allotments will thus be necessary, the result will obtain a correct silvicultural treatment over at least the greater proportion of each unit and in most cases over the whole unit.

Regeneration of In.—The problem confronting the regeneration of the Regeneration Block is to establish the new crop in as short a time as possible over each unit, in order, among other things, to concentrate fellings, which will increase the money yield, and to avoid damage by successive fellings. In this Block, the soil covering contains about 600-800 suppressed *in* seedlings per acre, mixed with *ingyin* in places, both of which have probably been on the ground and annually burnt back anything up to 50 years or so. It is consequently a matter of establishing existing suppressed seedlings as much as a question of inducing additional seedling regeneration.

In is a great light-demander and requires complete side light before it becomes established as pole growth. In the past, seeding markings have varied between heavy and light but very

little information can at present be deduced as to the number of operations required or the correct spacing of seed-bearers as the lease covering the Regeneration Block has been temporarily inactive. One virgin compartment was practically clear-felled over no advance growth, a few years ago, owing to over-lapping of compartments among blocks referred to above. This compartment is now a mass of exposed *in* seedling regeneration, smothered in high *thekke* grass. Under such conditions the locality will burn over fiercely for many years and in the absence of expensive fire protection, there is no doubt that it may take 10-20 years of annual burning back before the *in* becomes established above the fire danger.

On the one hand, it is necessary to make really large gaps in the cover to ensure side light whereas on the other hand they should not be so large as to encourage an unduly thick growth of *thekke* grass which will retard regeneration for years.

It is believed that one heavy seeding felling, followed by a final felling may suffice and this year not more than about 8 seed-bearers per acre have been left. Within a few years, aided by experimental plots already under observation, it will be possible to come to some conclusions on the correct degree of seeding fellings. At present, general observations indicate that the new crop may be established within 4 or 5 years by two successive fellings.

Ingyin (*Pentacme suavis*) *regeneration.*—The Plan provides for the encouragement of *ingyin* as against *in* where possible. *Ingyin* probably remains in the burnt-over or whippy stage even longer than *in.* From the observation of root-stems, no *ingyin* sapling was found established above the fire zone with a root-stem diameter of less than $\frac{3}{4}''$ and seldom under $1''$.

Ingyin is more affected by annual fires than *in* and the best method of encouraging *ingyin* to establish is by fire-protection. This has already been amply proved by experimental plots in the vicinity and has been introduced in one compartment. *Ingyin* is less of a light demander than *in* and its regeneration is also encouraged by lighter seeding fellings within the area of its seed-fall.

Waste of timber involved. Another problem is the waste of immature timber involved in the conversion of an uneven-aged

forest to one of even-age. This so-called waste is largely a myth in this case. Trees are marketable down to 5′ 6″ girth if cylindrical and at most 6′ and fuel is saleable from some accessible areas. Under an alternative selection system, which has been mooted by some officers for this reason, waste would also be in considerable evidence, as large gaps would have to be made in order to establish any regeneration at all. Under this system, it would also be more difficult to encourage *ingyin* regeneration because there is far less elasticity in controlling the position of seed-bearers. The uniform system has the great advantage of concentration which must result in a higher money yield and will eventually produce a crop many times the value. However, it is not possible to lay down the law on this point until more data are collected. If the present sacrifice of immature timber is proved to be uneconomical, there are several ways of counteracting it without altering the system. One is to adopt a longer regeneration period during the first rotation. Another is to leave isolated well-spaced trees with long clean boles, 4′ to 5′ girth, about 6 to 8 to the acre, to carry on to the next rotation. This will not interfere with the final spacing of the new crop, although it will reduce the outturn of rafting poles under thinnings which have a good market. This method has been applied to one compartment this year.

There seems no doubt that silviculturally the group system or the modification proposed by Sir Peter Clutterbuck for the sal forests of Northern India is ideal for this forest. Such methods, however, are quite impracticable here at present as the work over such a large area would be too intensive and scattered. It could be introduced with success only if the locality were constituted as a separate Division.

The accompanying Plates Nos. 12 and 13 were kindly taken by Mr. A. Long, Instructor, Burma Forest School, during a recent visit of the school to the Reserve.

Dated 1st February 1929.

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FOREST RESEARCH WORK IN FRANCE.

Monsieur H. Perrin, Inspecteur Principal des Eaux et Forets of the Nancy Forest School, who will be remembered by former members of the Society, has recently published a brochure entitled "Les Recherches Forestieres en France," (*Annales Tom. II, Fasci. I.* 1928). In his little work *M.* Perrin traces the history of forest research in his own country, and in some respects this history has a striking parallel to the lines of progress in this matter in India. Although Colbert made the first beginnings of forest conservation in France so long ago as 1660, for nearly two centuries subsequently the utility of forestry research was called in question by the officers who had charge of the forests. These latter considered research as pure theory and that its application in the forest could have no practical value. For two centuries, therefore, its few advocates remained either without, or obtained only a partial, hearing during their life-time, and no advance was made. Amongst these early enthusiasts men such as Réaumur (1683—1757), Buffon (1707—1781), Duhamel du Monceau (1700—1782), and Varenne de Fenille (1700—1793) put forward tentatively new methods of management which were regarded as interesting but unpractical. The next proposals, based on German forms of management and German doctrines, were introduced into France by four men, Baudrillart (1774—1832), Lorentz (1775—1865), Parade (1802—1865), and de Buffevent (1787—1860). The German ideas were considered too theoretical to be of any use in French forestry, which, so the experts maintained, depended not on experiments and research, but on the practical observations and experience of the men in charge of the forests.

Nancy Forest School was founded in 1825 to train the officers of the French Forest Service on scientific lines. Amongst the first young officers thus trained were two men, Dessales de la Gibertie and E. Chevandier de Valdrôme. Between 1840 and 1850 these two men declared that if a better quality and larger volume of timber and other produce was to be obtained in the future from the forests, forest research work on a carefully laid down plan was necessary. The Government, however, in face of

the conservatism and disbelief of the forest staff, took no action. In 1861 an officer of the Service resigned in order to undertake a vigorous campaign in favour of a system of management which has since come to bear his name and is now used in the management of areas of forest in the Jura, in Switzerland and elsewhere. This officer's name was Gurnaud and his 'Method of Control', as it was termed, became the subject of animated discussion for a considerable period of years. Perrin states, however, that it may be regarded as having arrested the attention of French forest officers and led them to consider whether their long unquestioned acceptance of routine methods was in the best interests of the forests.

As evidence of the new position the Government issued a circular in 1873 ordering the establishment of sample plots of half a hectare in extent in the younger age classes in all State forests managed under the Shelterwood Compartment system—a system in common use in France. Unfortunately, although these plots were to be measured periodically, uniform methods in making the thinnings and calculating the resultant yield were not prescribed. The data obtained were, therefore, of little use for general purposes of comparison. The step thus taken is, however, of interest, since it marked the recognition by Government that research work might have some value.

A decade later a more important departure was made with the inauguration in 1882 of the Research Station at Nancy as an annexe of the Forest School, it being considered that instructional and research work should go hand in hand. With the object of realising this idea a certain number of the forests adjacent to Nancy were placed under the management of the School and Research Centre, and the Forest Nursery at Bellefontaine, a few kilometres from Nancy, was also made over to the School. Later on other forest areas were made over and research officers were also permitted to make use of neighbouring State forests for research work. The professors of the School, mostly drawn from the Forest Service, were responsible for the research work, but one gazetted Assistant was attached to the Research Station. In 1887 a Committee of these officers, including the Director of the

School, was established in order to co-ordinate the work and draw up the programme of research and so forth. The departure so initiated continued with one or two breaks up to 1914. Perhaps the most important result of the work undertaken during the period was the recognition, which gradually became stronger, that research work undertaken in forestry questions could have an immense practical importance, and by 1914 the lines of research had been more or less established through the successive efforts of Bartet, Claudot, Jolyet, de Bouville, Guinier, and lastly, Cuif. Money was the difficulty and the latter had directed attention to the enormous problems awaiting solution,—problems which had to be left in abeyance owing to the want of adequate funds.

All work ceased during the war but with the re-opening of the Research Station in 1919 Cuif's proposals were given consideration by the Government. The Director of the School was now placed in immediate charge of the Research Station with a Committee comprising the professors of the School and Conservator of Forests stationed at Nancy. Research work was organised into four sections: 1. Silviculture and forest economy; 2. Botanical, including the physical and mechanical properties of timber; 3. Zoology (entomology and pisciculture), and geology (study of forest soils); 4. Afforestation of denuded forest slopes, erosion and arrestation of dangerous torrents, etc. Assistants were attached to the professors in charge of these sections, and annual programmes were laid down by the Committee, and funds provided.

The research work undertaken deals with the whole of France, but valuable assistance is now obtained from a network of what may be termed sub-stations throughout the country which are in charge of Conservators or Divisional Officers (Inspecteurs) who have shown a liking and aptitude for research work. Now that the value of research has come to be appreciated by the Executive Officer, Perrin states that no difficulty has been experienced in inaugurating these local centres. On this subject he writes "Cette organisation d'annexes, nécessaire dans un grand pays oú les conditions forestiéres varient á 'infini, parait devoi

rendre les plus précieux services; elle décharge la Station de Nancy d'une besogne matérielle considérable, tout en faisant rentrer les travaux des annexes dans un cadre commun qui permettra ultérieurement de les rapprocher et, en meme temps: elle assure aux praticiens qui veulent étudier de plus prés certaines questions les directives et les subsides nécessaires."

In France, as has been so strikingly demonstrated in India, the War, with its enormous demands on the forests, has brought about a recognition on the part of the Government of the great importance of forest research work into the various problems of the forests if they are to be managed on lines which will yield the best results consistent with the varying locality factors.

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SLASH IN CHIR PINE (PINUS LONGIFOLIA) FORESTS.

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(*Indian Forest Records, Vol. XIII, Part VII, Government of India Press, Calcutta, 1928, 45 pages, 25 illustrations, price Rs. 3-6 or 5s. 9d.*)

This book deals in detail with all aspects of slash in Chir Pine Forests. It is based mainly on the conditions existing in the West Almora Division of the Kumaun Circle, United Provinces. All the forests are in the hills but the conditions are very varied ranging from forests such as those in the Ranikhet Cantonment, where the complete utilisation results in the removal even of the pine needles, to the remotely situated forests managed mainly for broad gauge sleeper production, where the strict specification of the Indian railways results in vast quantities of slash being left. The Division includes extensive resin tapping areas, pine plantations and areas under concentrated regeneration. The point of view of the inhabitants of the villages scattered amongst these forests is given the attention essential where fire is a very great danger owing to the local customs and past history. It follows, therefore, that the suggestions made are capable of wide application in Hill Pine Forests. One word of caution may, however, be given. The hill slopes in West Almora, while possibly fairly normal as compared with the average of hill forests are distinctly less steep than in other parts of the Kumaun Circle. The numerous and excellent photographic illustrations in the book indicate the nature of country dealt with.

The necessity for careful and systematic attention to the disposal of slash in pine forests will be appreciated by all who have seen the damage done by fires in areas neglected after fellings or who have attempted to carry out controlled burning of regeneration areas. The presence of slash in the latter may easily result in the destruction of half the regeneration on the ground

during controlled burning, its removal from a thicket of advanced regeneration is difficult and costly, while to leave the area untended is to run the risk of a holocaust in the hot dry weather which will kill out not only all the young regeneration but also the remaining seed bearers. The temptation will constantly arise to postpone the disposal of slash from fellings owing to the presence on the ground of young seedlings or the occurrence of a good seed year coinciding with the fellings but it must be firmly withstood. The comparatively small damage done to the forest by the prompt disposal of slash and by burning under control immediately after fellings is infinitely preferable to the almost inevitable damage which results from leaving the slash scattered over the forest.

The book deals not merely with slash from main regeneration fellings but from every conceivable source. The suggestions made by Mr. Turner are the result of actually introducing this work over a protracted period and in circumstances of considerable difficulty. He is to be congratulated on having placed on record a valuable account of this important work, which will be of help to all who have to deal with Slash disposal.*

F. C.

THE TREES OF NEW ZEALAND.

BY L. COCKAYNE AND E. P. TURNER.

This book was prepared in the first place to supply the delegates of the Third British Empire Forestry Conference with a short account and means of recognizing the trees of New Zealand and secondly for the benefit of New Zealanders who take an interest in the trees of their country.

The first chapter deals with the forests as a whole and seems unduly to stress the tropical character of the forests. The authors state that the New Zealand Forests come into the same class as that type of tropical lands known as rain forest. Eleven points of resemblence to the forests usually called Tropical

* NOTE.—A printing mistake occurs on page 39 of the Record—"previously concerned action" should be "previously concerted action."

evergreen by Indian foresters are mentioned as follows: (1) The trees are nearly all evergreen and belong to many genera. This, however, applies equally well to the forests of S. Africa and Australia except that in this case the genus Eucalyptus is so remarkably developed that it overshadows all the other genera and gives a character to the Australian forests not found elsewhere. Possibly it is not sufficiently realized that the trees of the upper storey in the tropical evergreens are mostly deciduous. (2) The development of plank buttresses. This is a character of the mangroves not of the tropical evergreens. It is true that in the tropical evergreens some genera such as Sterculia develop plank buttresses but for one that does so ten do not. The example of plank buttresses most familiar to Indian foresters *viz.*, *Bombax malabaricum* is not a tree of the tropical evergreens and incidentally is not evergreen. (3) Flowers are produced by certain species on the naked stems and in one species on the trunk itself. This character is certainly found in some trees of the tropical evergreens but it is not characteristic of the vegetation. In forests where the number of species is very large abnormal types are likely to be met with and the chances of resemblances being found are also larger. Accidental resemblance seems to meet this case adequately and it is unnecessary to claim a close similarity of conditions. The cauliflorous species in New Zealand—*Dysoxylum spectabile* belongs to a genus which in the Malay Peninsula is represented by 17 species only 3 of which are cauliflorous. (4) Nearly always roots extend far through the surface soil and frequently project above it. This character is typical of the mangroves but not of the tropical evergreens though found in certain genera such as *Ficus* and *Artocarpus*. (5) The presence of woody lianes and high-perched epiphytes. This is characteristic of the tropical evergreens but is equally so of the temperate rain forest. It implies very favourable conditions of rainfall and temperature but not necessarily tropical conditions. (6) Presence of tree ferns and numerous species of herbaceous ferns. This is undoubtedly the most striking feature of the New Zealand forests and brings to mind the forests near Darjeeling and even more those in moist valleys in

Tasmania. It does not suggest the tropical rain forest of Malabar or Tenasserim where ferns are not particularly conspicuous.

It is scarcely necessary to go over the remaining points in detail. The paragraph is summed up in the last sentence "In short the forests exhibit extreme luxuriance of growth, and Nature, as it were, runs riot." The New Zealand forests represent the best class of rain forest but temperate not tropical rain forest. The surprising number of species found in the tropical evergreens where the first impression is that no two trees visible from any one point are the same, is absent in New Zealand where the number of trees and shrubs together is said to be 168.

The rest of the book is mainly taken up with a short account of the "trees" a great number of which as ordinarily seen in New Zealand are shrubs and not trees. Each species is illustrated by an excellent photograph showing as a rule a fresh twig with flowers or fruits. In a few cases pressed specimens have been used.

The Handbook must have been very greatly appreciated by the delegates to the Forest Conference and the reviewer regrets that it was not available in 1926.

R. N. P.

EXTRACTS.

LESS PROFITABLE PUNJAB FORESTS (PROBLEM OF EROSION CALLING FOR SPEEDY ACTION.)

THE FOLLOWING IS ISSUED BY THE PUNJAB GOVERNMENT INFORMATION BUREAU:—

The report on forest administration in the Punjab for the year ending March 31, 1928, shows that the area under the control of the Department was 5,534 square miles at the end of the year. There was thus a reduction of 1,115 square miles, of which 1,114 square miles were disforested for colonisation, mostly in the Nili Bar.

The area administered under the Forest Act 1927 of the rules of 1855 by the Civil and Military Departments decreased during the year from 805 to 804 square miles. The process of disforestation for colonisation is nearly complete, the work of the Department will, therefore, be concentrated in future mainly on commercial and protective forests, and the eight irrigated plantations.

WORKING PLANS.

Great progress was made with the preparation and revision of working plans, under the supervision of the Conservator of the

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newly constituted Working Plans and Utilization Circle. This is very satisfactory and it is hoped that in a short time every acre of genuinely forest area in the Punjab will be worked under an up-to-date working plan.

The working plan prescriptions have been generally followed with the exception of fellings in Kangra, which were allowed to fall into arrears pending the advent of the Kangra Valley Railway, when it is hoped timber will fetch much better prices. The fellings of spruce and fir timber have continued their sagging owing to the poor market demand.

COMMUNICATIONS.

Twenty-one miles of unmetalled cart roads and 68 miles of paths were constructed during the year at a cost of Rs. 17,818 or Rs. 200 per mile.

Repairs were made over 1,958 miles of roads and paths and 21 miles of tramways at a cost of Rs. 27,737. The state of many of the hill bridle roads, notably in the two Rawalpindi Divisions is not satisfactory. For reasons of financial stringency economy has been practised in regard to road repairs. It is, however, proposed to draw up a regular programme of road re-conditioning and repairs consistent with economy.

The expenditure on new buildings increased from Rs. 50,325 to Rs. 57,194. About 64 per cent. of this amount was incurred on the construction of quarters for the subordinate forest staff.

FOREST PROTECTION.

There was a steady increase in forest offences, and the year's total exceeded 14,000 cases. That 70 per cent. of these offences can be ascribed to the pressure of grazing and browsing upon Government forests, is an eloquent testimony to the conflict between the claims of grazing and forest regulation.

As in former years the highest percentage of offences occurred in the submontane tracts of Rawalpindi, Jhelum, Kangra and Hoshiarpur, due mainly to the denudation of village forest lands.

It is unsatisfactory to find that the number of cases disposed of was only 42 per cent. of the total number for disposal. The

percentage of convictions was 92·27 as compared with 84·78 last year. The punishments awarded were generally adequate except in certain courts in the two Rawalpindi Divisions and the attention of the District Magistrate has been drawn to this.

It is satisfactory to note that the number of fires decreased from 323 to 201 during the year. Only 66 of these were classified as malicious or for the purpose of obtaining fresh grass. The remainder were due to accident or carelessness.

GRAZING FACILITIES.

Only 167 square miles or less than 3 per cent. of the total forest area was entirely closed to grazing by cattle and 1,024 square miles or 19 per cent. to browsing by sheep and goats. The bulk of the area closed to grazing was open to grass-cutting and only 25 miles remained entirely unutilized for the supply of fodder.

THE FACILITIES OFFERED BY THE DEPARTMENT FOR GRAZING ARE, THEREFORE, MOST GENEROUS; BUT IT IS CERTAIN THAT EROSION AND DESICCATION HAVE DONE IRREMEDIABLE DAMAGE OVER EXTENSIVE AREAS, AND SPEEDY ACTION IS CALLED FOR IF IMPORTANT SECTIONS OF THE POPULATION ARE TO BE SAVED FROM CERTAIN RUIN.

The proposals of the special officer deputed to inquire into the matter should engage the earnest attention of the Government and the Punjab Legislative Council.

Apart from the all important problem of erosion, the Punjab forests are on the whole not greatly affected by natural enemies, but the ravages of insects and fungi have done considerable damage in places.

REGENERATION.

There have been some inevitable setbacks in the progress of areas under regeneration, but the big Kulu and Seraj deodar forests are keeping reasonably up to the mark, though the other big area in Rawalpindi East and West has a lot of deficiency to make up. Satisfactory progress was made in regard to afforestation in irrigated plantations and 1,768 acres were successfully stocked with *shisham*.

EXPLOITED AREAS.

The area exploited was 93,340 acres as compared with 134,040 acres during the previous year. The decrease was due to slackness in reproduction caused by the irregularity of seed years and to the lack of demand for *chir* timber.

The total value of timber, firewood and minor produce extracted by departmental agency amounted to Rs. 21,50,730 against Rs. 33,36,806 during the previous year. There was a decrease in the quantity of timber and minor produce extracted by purchasers on account of less timber having been sold in Kangra owing to the dull market and also on account of restricted supplementary fellings in Rawalpindi East.

RIGHT-HOLDERS.

Right-holders continued to enjoy a very substantial share of the forest produce including 31 per cent. of the total production of timber, 79 per cent. of firewood and 77 per cent. of minor produce.

These figures do not appear in the profit and loss account of the Department but are a sufficient index of one side of its beneficent as opposed to its commercial activities.

In most of the hill and depôt Divisions the stocks of timber have been reduced; Seraj and Rawalpindi West are the exceptions. Improved transport by tramway was responsible for the accumulation of additional stocks of timber and firewood at Changa Manga. In Rawalpindi West the stock of firewood was reduced considerably. Imports of foreign timber showed an increase of over a million cubic feet.

FINANCIAL RESULTS.

The net cash surplus on the year's working amounted to Rs. 2,38,849, or a drop of about 5½ lakhs as compared with the previous year. If to this are added Rs. 3½ lakhs on account of the sale-proceeds of timber, which should ordinarily have been realised during the year under review, but were credited at the close of the year, there still remains a balance decrease of nearly Rs. 2 lakhs.

This decrease is due to the operation of a variety of causes the chief among which are the smaller sales and lower prices of firewood owing to the glut in the market, consequent on the rapid clearance of *rakhs* for colonisation and to the smaller demand and production of timber and the fall in its price.

The prospects for the future are not very encouraging either and it may not be possible to maintain the ratio of 7: 10 between expenditure and income, which is one of the established conventions of the Department. The net expenditure decreased from Rs. 31,20,776 to Rs. 29,54,962 and includes substantial capital expenditure incurred during the year.

RESEARCH OFFICER NEEDED.

A number of experiments were made and valuable results obtained during the year. It seems clear, however, that the work in this line cannot yeild really satisfactory and sustained results until a special research and statistical officer is appointed. Although a provision exists for this it has not been possible to fill the post for want of an experienced officer.

Further experiments are required before the correct treatment of *kail Priners excelsa* forest under regeneration can be determined. Valuable experiments have been carried out on the economic use of water in irrigated plantations.

(*Civil and Military Gazette, 18th February 1929.*)

LEGISLATIVE ASSEMBLY—RAILWAY SLEEPERS.

ADVANTAGES OF USING WOOD FOR CONSTRUCTION.

Mr. Sesha Iyenger in a motion for a token cut, drew attention to the policy regarding purchase and use of steel sleepers in Indian Railway.

He said there was enough wood in the country for use in the railway. Wooden sleepers had been tried and not found wanting in the matter of durability, price and convenience to the travelling public.

It was an anomaly to import steel sleepers from abroad, when there was enough material at home.

Mr. Aney held that there was a shrewd suspicion in the minds of the public that steel was imported to solve the unemployment problem in England. He urged that Government should utilise the services of the Forest Research Institute, Dehra Dun, to discover the best quality of wood which was most suitable for Railway sleepers.

Mr. Vidyasagar Pandya urged the institution of a forest research institute in South India.

The debate was in progress when the House rose for lunch.

AN EFFECTIVE FACTOR.

Re-assembling after lunch the House resumed the discussion on the Steel Sleepers Purchase Policy of the Railways.

Mr. Jogiah urged the total stoppage of the import of foreign wooden sleepers as they, being of softer wood, were not so durable as the Indian ones.

Mr. Chalmers (non-official, Assam) also supported the motion and said wood from the vast Indian forests could easily supply the entire requirement of the Railways.

Mr. Parsons, replying to the debate, said nothing could be said in favour or against wooden, iron or steel sleepers. Price was the only effective factor which controlled their purchases. The life of wooden sleeper was roughly 14 years, while that of iron and steel was 35 and 50 respectively.

Proceeding, he said at present the Tata Iron and Steel Company was the only steel-producing concern in India and it could not supply their entire requirements. Government were not unmindful of the timber resources of the country and had placed orders for a good many sleepers, but they felt prices were unfavourable as compared to other types of sleepers.

The motion was negatived by 55 votes to 43.

WOODEN SLEEPERS.

At a conference between Sir Austen Hadow, Chief Commissioner of Railways, and members of the South India Chamber of Commerce at Madras on 4th January, one of the questions

discussed was the supply of wooden sleepers. The Chamber pointed out that the Indian Railway Companies have been for a long time importing both steel sleepers and wooden sleepers from foreign countries. Experiments have been made in several countries as to the comparative merits of the two in point of life and cost, as a result of which even Britain and the United States, the home of iron and steel, have been making extensive use of wooden sleepers. It is also reported that the Railway Companies have made it a point to fix too exacting specifications for tenders in India. Could not the immense forests of India supply enough timber for a few lakhs of sleepers required by the Indian Railways?

The Commissioner stated that it would not be possible for India to supply the particular sleepers required for different railway systems. Further, steel sleepers were cheaper and therefore sleepers had to be imported from abroad.

(*Capital*, 10*th January* 1929.)

SHELLAC IN INDIA.

The Department of Industries in Bengal has brought to notice that the Shellac Industry is not doing too well. The matter is not on a par with the loss of the Indian indigo industry owing to the manufacture of synthetic indigo, as a synthetic product to displace shellac has not yet been produced. But there are signs that the modern scientific chemist will produce certain cellulose products which tend to make shellac much less indispensable, and to combat this competition it appears to be necessary to improve the cultivation of lac-bearing trees and to place on the market shellac which shall be better and more standardised in quality and at a cheaper rate. Otherwise for want of intelligent interest in the industry, it may be beaten out of the field.

THE COOPER'S HILL CHALLENGE CUP.

The visit to Australia in 1928 of the Third Empire Forestry Conference will undoubtedly achieve far-reaching, and very

material results. Quite apart from the tangible evidence we shall have in the form of its Report and Resolutions, of solid work done by the Conference, much good must result from personal contact between men who are serving the same interests under such a variety of widely different conditions.

One very interesting result of the Conference was the establishment of a link between the oldest Forestry School in the Empire and the youngest—Cooper's Hill and Canberra. Old students of Cooper's Hill were well represented in the strong delegation sent by India, and it was a singularly happy thought on the part of the Cooper's Hill foresters to present a Cup for competition amongst students at the recently established School at Canberra.

(*The Australian Forestry Journal*).

ATTEMPT TO CONQUER EVEREST.

A BRITISH EXPEDITION IS TO MAKE ANOTHER ATTEMPT TO CONQUER MOUNT EVEREST.

Professor N. E. Odell, of Harvard University, who was a member of the 1924 expedition, announces that a British expedition will make another attempt to conquer Mount Everest, says a message from Montreal. It is hoped, he states, that the difficulty arising from the Dalai Lama's refusal of permission will soon be overcome.

Professor Odell's heroism was one of the outstanding features of the 1924 expedition. This was in connexion with the final attempt made by Mr. G. L. Mallory and Mr. A. C. Irvine to scale the summit of Mount Everest. One report at the time stated :—

"There was still one more attempt to be made by Mallory and Irvine. There had been defects in the oxygen apparatus and but little oxygen was now available.

FINAL EFFORT.

They were assisted by a supporting party consisting of Odell and Hazard who accompanied them to the 25,000 feet camp,

This point, on June 6, they left with porters, who again carried loads for them to 27,000 feet.

On June 8, they left camp 6, the highest camp, for their attempt. Odell on that morning arrived at the camp to watch their progress and report on it and to take such steps for their comfort as were considered necessary.

Odell caught a glimpse of the climbers high up on the mountainside for a short space of time; the mists blew across and he saw them no more. Returning to camp 4 he awaited their return, but on the following morning, seeing no signs of them, he searched with signal and magnesium flare the whole hillside without effect.

On June 10, for the third time, he mounted the slope to 27,000 feet—in itself an unprecedented effort— but could find no signs of Mallory and Irvine, and, communicating with Lt.-Col. E. F. Norton, evacuated the mountain."

(*Statesman*).

FLORA OF THE KARROO.

Reports have been received by the Agricultural Department from Burgersdorp and Fauresmith that those areas, once grass veld, are now becoming karroo.

The karroo flora is highly specialized, and cannot exist in typical grass veld owing to shading and moisture. Once the grass covering is destroyed by over-stocking, a condition favourable for the establishment of a karroo flora is created, and it slowly but surely forces its tentacles into such areas.

One of the Department's experts, speaking at a conference, said that the encroachment of the karroo, which was often taken as a sign of drier conditions, was really brought about by the interference of man. In the karroo there was flora which, botanically, was one of the wonders of the world—a flora which had become adapted to dry and arid conditions: a flora which, if properly treated, would probably carry sheep farmers over many a drought. From the karroo was coming the cry: "Our good karroo bushes are disappearing, and useless bushes are taking

their place." This was indeed the case, and what was worse, there were patches in the karroo absolutely denuded of all vegetation. The only way to reverse this state of affairs was by means of scientific investigation of the typical karroo flora and its reaction to over-grazing and over-stocking.

(*The Times.*)

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INDIAN CLIMBING ACACIAS OF THE CAESIA GROUP.

In the Kew Bulletin 1915 p. 407 et seq. W. G. Craib writes an interesting article on the Indian Acacias hitherto referred to *A. Intsia*, Willd. and *A. caesia*, Willd. He concludes that *A. Intsia*, Willd. should be excluded from the Indian flora and that the Acacias hitherto referred to these two species belong to at least 6 species which he defines. As Craib does not give a key to the species and only quotes herbarium sheets for two of them, his classification is difficult to follow. I, therefore, obtained on loan from the Calcutta herbarium the available material of these forms, for which I have to thank Lt.-Col Gage, with the object of testing Craib's conclusions and of making a key to the species.

The Acacias described by Craib with the exception of *A. Hohenackeri*, Craib are closely related to one another and may be distinguished from the other Indian climbing acacias by their flat thin pods which exclude *A. concinna*, DC. and *A. rugata*, Ham. and by the leaflets being attached at the centre of the base instead of at the upper angle as in *A. pennata*, Willd. On this latter character Craib himself distinguishes *A. Hohenackeri* as in his diagnosis he writes "Ab *A. caesia*, Willd., foliolorum costa basi valde obliqua haud centrali facile distenguenda".

A. Hohenackeri, Craib is not a member of the Caesia group as here understood but is very close indeed to *A. pseudo-Intsia*

Miq. var. *ambigua*, Prain in Journ. As. Soc. Beng. LXVI 2 p. 249 from the Andamans. In var. *ambigua* the bracts are large, ovate, acute, glabrous. Peduncles densely canescent but not glandular. The flowers minutely pedicellate and ovary glabrous. In *A. Hohenackeri* the peduncles are glandular pubescent and the ovary is villous. The bracts are unfortunately not shown in a photograph of the type in Kew. In the co-type in Calcutta they have all fallen off. *A. Hohenackeri*, Craib, if really specifically distinct from the Andaman plant is much more likely to be confused with it than with any of the Caesia group.

In the species of the Caesia group the pods are remarkably variable in length width and number of seeds. The size of the leaves and number of pinnae and leaflets are very variable, the size particularly in *A. caesia*, Willd. and the number of leaflets in *A. torta*, Craib and *A. Gageana*, Craib. In *A. caesia*, Willd. and *A. oxyphylla*, Graham the leaflets tend to be separated from one another by a distinct interval but in the other species they are usually close and touching one another. This character needs to be used with caution especially in leaves which have been picked before they are fully developed.

The stem is deeply fluted in *A. torta*, Craib, *A. Gageana*, Craib and *A. oxyphylla*, Graham and probably in the other species as well.

In examining the material in Calcutta and Dehra Dun one additional species has been detected which is described below. Craib probably never saw this species but he apparently thought that there might be additional species related to *A. Gageana* since he makes no mention of *Acacia alliacea* Ham. in Wall. Cat. 5258. I delayed publication of this note until I had seen this number in Wallich's Herbarium. Gamble has already noted on the sheet that it is *A. Gageana*, Craib an opinion with which I fully agree. At the same time there are possibly additional species related to *A. Gageana*. My No. 2179 from Tavoy distributed as *A. Gageana*, is not typical, differing in the venation of the leaflets and in other minor points. Burmese material of these climbing Acacias is extremely scanty in herbaria and several

species might be expected to occur in Burma, not necessarily identical with the Indian forms.

Key to the Species.

Glands on the petioles always solitary; bracteoles not acuminate.

Petiolar gland flat or conical.

Flower heads in bud pubescent.

Leaflets rather distant, 6-14 pairs on each pinna ... ... *1. A. caesia.*

Leaflets close and touching, usually 25-40 pairs on each pinna ... *2. A. torta.*

Flower heads in bud glabrous or very nearly so.

Leaflets close and touching 1-nerved, the second nerve weak and scarcely reaching half-way up the leaflet ... *3. A. Gageana.*

Leaflets not touching, rather strongly 2-nerved to near the apex ... *4. A. oxyphylla.*

Petiolar gland columnar ... ... *5. A. columnaris.*

Glands on the petiole usually two; bracteoles long acuminate, very conspicuous in young flower heads ... ... *6. A. diadenia.*

1. *Acacia caesia, Willd. Sp. Pl. IV* (1805) *p. 1090. Mimosa caesia.* Linn. Sp. Pl. (1753) p. 518 (quoad plantam zeylanicam).

Young shoots, petioles and inflorescence more or less (in the herbarium yellowish-brown) pubescent. Gland near the base of the petiole and those between the upper pairs of pinnae convex one or more small oblong glands usually present on the pinnae between the upper pairs of leaflets. Pinnae (4) 5-6 (-7) pairs. Leaflets 6-14 pairs, not touching, ciliate and pilose beneath when young, glabrous or nearly so when mature, variable in size 7-18 by 3-8 mm. rather strongly 2-nerved for two-thirds their length. Peduncles 1·5-2 cms. long, densely grey-pubescent. Heads 25-30 flowered. Bracts lanceolate, acute, longitudinally nerved.

Bracteoles 1·5 mm. long, linear-spathulate, densely pubescent. Calyx 2 mm. long, densely pubescent. Corolla 3 mm. long pubescent. Ovary villous on a stipe ·5 mm. long. Pods 8-12 by 2·5-2·8 cms. glabrous from an early stage.

Type from Ceylon collected by *Hermann* and preserved in Herb. Mus. Brit.

I have seen the following specimens:—

Bengal: *Herb. Calc. Herb. Dehra,* Sunderbans.

Orissa: *Herb. Dehra. Haines* 4236, Khurda, *Haines* 18490. Cuttack v.v.

Madras: *Herb. Calc. Cleghorn; Wight* 575, 578, 604, 895

Tinnevelly, *Hooper and Ramaswami* 39301. Herb. Dehra. Cuddapah *Fischer*; Chittoor *Menon.*

Bombay: *Herb. Calc.* Ritchie 1736/2; Guzerat, *Stocks* 276

Ceylon: *Herb. Calc. Thwaites* C. P. 1519.

Yunan: *Herb. Calc. D. J. Anderson.*

Cult. in Hort. Bot. Calc. *Herb. Calc.* Wall. Cat. 5248D, 5252B &c; *Herb. Dehra.* Cult. Dehra Dun v. v.

Craib in Kew Bull. 1915 p. 409 mentions a specimen of Hamilton's from Nawabganj, United Provinces, which appears to be the northern limit of this species. It has not been found in the Sub-Himalayan tract and evidently does not occur there.

2. *Acacia torta, Craib in Kew Bull.* (1915) *p.* 410. *Mimosa torta,* Roxb. Fl. Ind. II (1832) p. 566.

Young shoots, petioles and inflorescence more or less densely (in the herbarium reddish-brown) pubescent or rarely nearly glabrous. Gland near the base of the petiole obliquely conical, those between the upper pairs of pinnae convex, all more or less pubescent. Pinnae (7-) 10-14 (-19) pairs. Leaflets (6-) 25-40 (-42) pairs, close and touching, ciliate, nearly always pubescent on both surfaces, 4-8 by 2-3 mm. 1-nerved, the second basal nerve much weaker and scarcely reaching half way up the leaflets. Peduncles 1-2 cms. long, densely pubescent. Heads about 30 flowered. Bracts very small, linear, villous. Bracteoles scarcely 1·5 mm. long, linear-spathulate, villous. Calyx 2 mm. long,

pubescent. Corolla 3 mm. long, slightly pubescent. Ovary villous on a stipe 1 mm. long. Pods 10-15 by 2-3 cms. brown-velvety when young.

No type specimens appear to exist. The species is based upon Roxburgh's description which with the locality "mountains of Coromandel" is sufficient for recognition. There is an unpublished figure of Roxburgh's in Kew and Calcutta.

I have seen the following specimens :—

Punjab: *Herb. Calc.* Nurpur, Kangra, *Brandis;* Hoshiarpur *Aitchison ; Herb. Dehra.* Chamba State, Dunera, *Drummond* 44; Hoshiarpur, *Aitchison.*

United Provinces: *Herb. Dehra.* Saharanpur Siwaliks, *Hearle ;* Kumaon, *G. K. Sirkar.*

Bengal: *Herb. Calc. Griffith* 1924.

Chota Nagpur : *Herb. Calc. Wood* ; *Prain* ; Singbhum, *Haines, Gamble* ; Sonthal Parganas, *Kurz* ; Ranchi, *Gamble* ; Manbhum, *Campbell. Herb. Dehra. Campbell.*

Orissa : *Herb. Calc.* Dompara, *Ball.*

Central Provinces: *Herb. Calc.* Saugor ; Khandwa, *Duthie. Herb. Dehra.* Khandwa, *Lowrie ;* Hoshangabad, *Hole,* Melghat, Berar, *Witt.*

Bombay : *Herb. Calc.* Mahabaleshwar ; N. Kanara, *Talbot.* 467.

Madras : *Herb. Calc.* Malabar ; Coimbatore, *Fischer* ; Ganjam, *Gamble* ; Godavery *Bourne, Ramaswami ;* Nellore, *Ramaswami* 1231 ; *Cleghorn* ; *Wight* 891. *Herb. Dehra.* Chittoor *Fischer.*

Mysore : *Herb. Calc. Barber* 6969 ;

Travancore ; *Bourdillon* 657.

Cult. in Hort. Bot. Calc. *Herb. Calc. Herb. Dehra.*

This species has the widest distribution in India of any of the group. In the Sub-Himalayan tract of the United Provinces it is less common than *A. Gageana* and it does not appear to occur at all in Sikkim or Assam.

3. *Acacia Gageana, Craib in Kew Bull.* (1915) *p.* 409. *A. alliacea* Ham. in Wall. Cat. 5258 !

Young shoots, petioles and inflorescence more or less pubescent the pubescence somewhat glandular especially on the peduncles. Gland near the base of the petiole small, orbicular, sessile, pubescent, small sessile glands often present between the three upper pairs of pinnae, sometimes 1-3 small glands on the pinnae between the upper pairs of leaflets. Pinnae 7-14 pairs. Leaflets (6—) 20-30 (—40) pairs, close and usually touching, mostly acute with the point directed forward, ciliate, glabrous above, hairy on the nerves beneath, 6-12 by 2-4 mm. 1-nerved, the second basal nerve weak and scarcely reaching half-way up the leaflet. Peduncles 1·5-2 cms. long. Heads 20-30 flowered. Bracts linear, acute. Bracteoles ·7 mm. long, minutely pubescent, somewhat boat-shaped. Calyx 2-2·5 mm. long the teeth slightly hairy at the tips. Corolla 2·5-3 mm. long, glabrous. Ovary glabrous on a stipe ·5 mm. long. Pods pubescent when young, glabrous when mature very variable in size 13-15 by 2—3 cms.

The type is Hooker's specimen from the low hills of Sikkim in Herb. Kew. The sheet in Herb. Calc. is clearly the same plant.

I have seen the following specimens :—

N. W. India Herb. Calc. *Royle.*

United Provinces *Herb. Dehra.* Kalsi, *Kanjilal* 920; Haldwani.

Raghubir Singh 24, *Manohar Lal* 148; Almora, *Duthie* 2839, Kalsi, *Parker* 58a, 70; Saharanpur Siwaliks, *Parker.*

Sikkim Terai *Herb. Calc. Hooker*; *Gamble* 4081c; *Kurz*; *King* 4929.

Herb. Dehra. T. Anderson; *Gamble* 4082, 4081b.

Bengal *Herb. Calc.* Dacca, *Clarke* 16730A.

Assam *Herb. Calc. Jenkins.*

Cult. in Forest Park Dehra. *Herb. Dehra.* Cult. New Forest Dehra Dun v. v.

This species is most closely related to *A. torta*, Craib which it replaces in the moister portions of the Sub-Himalayan tract and in Assam. It is best distinguished from *A. torta*, Craib by the flower heads which in bud are practically glabrous, the bracteole

half as long as in *A. torta* and of a different shape and leaflets glabrous on the upper surface. Although the ovary appear to be always glabrous it becomes pubescent on swelling after fertilization.

4. *Acacia oxyphylla, Graham ex Craib in Kew Bull.* (1915) *p.* 409.

Young shoots, petioles and inflorescence grey-canescent. Gland near the base of the petiole conspicuous, swoollen, flat-topped, a similar but smaller gland between the distal pair of pinnae and often a small flat gland at the apex of the pinnae. Pinnae (3-) 6-9 pairs. Leaflets (8-) 12-20 (-24) pairs, not touching, slightly ciliate, very inconspicuously addressed hairy beneath, variable in size 8-12 by 3-4 mm. rather strongly 2-nerved to near the acute apex which is often directed forwards. Peduncles 1·5-3 cms. long, densely grey pubescent. Heads 40-50 flowered. Bracts lanceolate, acute, longitudinally nerved. Bracteoles flat, oblong. 1 mm. long ·5 mm. broad, minutely pubescent or nearly glabrous. Calyx 2-2·5 mm. long, glabrous or slightly pubescent in the lower portion. Corolla 2·5-3 mm. long, glabrous or slightly pubescent in the lower portion. Ovary hairy on a glabrous stipe 1·5 mm. long. Pod up to 20 by 3·5 cms. glabrous or nearly so from an early stage.

The type is from Sylhet Wall. Cat. 5252A.

I have seen the following specimens :—

Bengal *Herb. Calc.* Sikkim, *Rhomoo* 187; Chittagong, *Lister* 16. Assam *Herb. Calc. Jenkins*; *Kurz* 43; *Masters* 601; *Gammie* 82; *Griffith* 1925; Arbor Expedition, *Burkill* 35999; *Prain's collector* 676; *Chatterjee*; Cachar, *Hook. f. and Thoms.*, *Shaik Mokim*; Sylhet, *Wall. Cat.* 5252A; Lushai Hills *Prazer*, *Gage. Herb. Dehra. Masters*, Sibsagar, *Kanjilal* 1820; Lakhimpur trans-frontier tract *Parker* 2138.

5. *Acacia columnaris, Craib in Kew Bull.* (1915) *p.* 410.

Young shoots, petioles and inflorescence densely (in the herbarium tawny) pubescent. Gland near the base of the petiole pubescent smaller columnar glands between (all?) the pinnae.

Pinnae 6-8 pairs. Leaflets 8-17 pairs, close and touching, pilose on both surfaces 5-10 by 2-3 mm. 2-nerved to near the apex. Peduncles 1·5-2 cms. long, densely pubescent. Heads 30-40 flowered. Bracts ovate-lanceolate, longitudinally nerved, acuminate, villous. Bracteoles linear-spathulate, 1·5 mm. long, villous. Calyx 2 mm. long, densely pubescent. Corolla 2·5 mm. long, densely pubescent. Ovary villous on a glabrous stipe 1 mm. long. Pods 10-12 by 2-2·5 cms. glabrous from an early stage.

The type is Hohenacker's No. 1643 from Mangalore in S. Canara in Herb. Kew and Mus. Brit.

I have seen the following specimens:—

Bombay *Herb. Calc. Herb. Dehra. Talbot* 622.

Coorg *Herb. Dehra. Lowrie.*

Craib gives as additional localities Mysore and Ceylon. The Ceylon record requires confirmation. Craib quotes Thwaites 1619 pro parte. According to Trimen Handbook of the Flora of Ceylon II p. 256 Thwaites C. P. 1619 is *Zehneria hastata*, Miq. with which an Acacia could not get mixed. Thwaites C. P. 1519 in Herb. Calc. is *A. caesia*, Willd.

6. *Acacia diadenia*, Parker sp. nova. *A tortæ* et *A. Gageanae* affinis, petiolo plerumque glandulis duobus instructo. Bracteoli florum capitulorum longe acuminati itaque gemmae squarrosae.

Young shoots, petioles and inflorescence more or less densely (in the herbarium brown) pubescent. Two conical glands on the petiole and 1-3 smaller glands between the upper pairs of pinnae, often 1 or 2 small flat oblong glands on the pinnae below the upper pairs of leaflets. Pinnae 7-11 pairs. Leaflets 17-30 pairs close and touching, 6-9 by 2-2·5 mm. linear-oblong, tipped with a prominent forward directed mucro, glabrous and dark green above, ciliate, paler beneath and hairy on the midrib. Peduncles 1·5-2·5 cms. long, bearing a small linear caducous bract at or above the middle, densely pubescent. Heads about 50 flowered. Bracts linear-subulate, villous. Bracteoles linear-acuminate, hispid, 2 mm. long, giving the heads a bristly appearance in bud. Calyx 2 mm. long, glabrous. Corolla 2·5 mm. long, glabrous. Ovary glabrous on a short glabrous stipe ·5 mm.

long, the stipe surrounded at the base by a short cylindric disk. Pod 10-15 by 2-3 cms. pubescent and glandular when young, sutures rather prominent.

Type Shaik Mokim in Herb. Calc. and Dehra.

I have seen the following specimens:—

Assam *Herb. Calc.* Cachar, *Prazer* 10; *Gage*; *Shaik Mokim*; Darrang, *D. Copeland*; Dumar Dullang *Watt.*

Burma Arakan ?

This species resembles *A. torta*, Craib in its vestiture and in its conical glands. In the shape of its leaflets it is very like some specimens of *A. Gageana*, Craib but has much more prominently mucronate leaflets. The long bracteoles which exceed the flower-buds are not found in any other Indian climbing Acacia but occur in *A. comosa*, Gagnep. of Cochin China which also has a glabrous pedicellate ovary. The petiole in *A. comosa*, Gagnep. is, however, eglandular and the bracteoles are glabrous (Fl. Gen. Indo-Chine II, t. 2, fig. 1).

DEHRA DUN:
4th April 1929.

R. N. PARKER, I.F.S.

REGENERATION OF EVERGREEN FORESTS IN MALAYA.

BY H. R. BLANFORD, I.F.S., CONSERVATOR FORESTS, BURMA.

Paper read before the third Silvicultural Conference held at Dehra Dun during March 1929.).

1. *Introduction.*—In view of the forthcoming discussion on the regeneration of evergreen forests at the Silvicultural Conference to be held in March some account of the work being done in Malaya may be of interest. On our way back from the Empire Forestry Conference in Australia and New Zealand, Mr. Shebbeare and I spent 10 days in Malaya and, thanks to the courtesy of the Conservator and members of the Malay Forest Service, were able to see several forests in which regeneration was proceeding. It is a pity that the invitation from the Federated Malay States government to all delegates to the Empire Forestry Conference to visit Malaya on their journey to or from Australia was not

taken more advantage of. In the following note I am indebted to Dr. Foxworthy, Forest Research Officer, and Mr. Rambaut of the Malay Forest Service for some additional information and data received after perusal of the original draft.

2. *General conditions in Malaya.*—What impressed me most in Malaya (especially coming from an under-developed country like Burma) is the magnificent network of metalled roads. Partly this is due to the nature of the climate and country, as communication without metalled roads would be exceedingly difficult with a distributed and heavy rainfall and the hilly character of the country ; but mainly there is no doubt that the development of the country is due to the tin and rubber industries. The development is especially marked on the West Coast drainage. The East Coast drainage is apparently far less developed and contains large areas of almost unexplored forests.

3. Naturally this network of roads renders a considerable area of reserved forests accessible and, near the tin mining centres, there is a strong demand for fuel and poles ; the poles being used mainly for the high sluices used for washing the tin. There is a tendency to adopt electric power for mining and this will probably lead to a decrease in the demand for fuel. At the same time cheap power will allow many mines, now unworked on account of high cost, to be worked economically and will increase the demand for poles and inferior timber for revetting and temporary structures. The rubber industry does not raise a great demand for forest produce but has hardly been behind tin in its effect on the general development and prosperity of the country.

4. *Climate.*—The climate is characterised by the lack of sharply marked seasons. Observations covering 17 years, in Kuala Lumpur, have shown that each month in the year has, at least once, been the month of heaviest rainfall. In the virgin forest the atmospheric humidity is high and uniform.

5. *Types of Forests.*—Over the greater part of the country evergreen forest occurs and though this differs considerably from place to place in its constituent species the main type varies but little. No separate sub-types of evergreen have yet been recognised with the possible exception of *kapur* forest which is characterised by an

abundance of *kapur* (*Dryobalanops aromatica* Gaertn f.). Classification has been based principally on elevation, everything over 2000′ being considered at present as inaccessible. Mr. Cubitt (*i*) describes these forests as follows :—

"The lowland (or dipterocarp) forests are the most imposing in the country. They consist usually of a number of storeys of which the uppermost may average a hundred and fifty feet or more in height; but individual trees of certain species, *e.g.*, *tualing* (*Koompassia parvifolia* Prain) commonly exceed two hundred feet in height and are alleged to have reached three hundred feet. The undergrowth is always thick, and it is impossible to move freely through it. Bamboos, except in certain well defined areas of comparatively limited extent, are usually absent, but a heavy undergrowth of *bertam* (*Eugeissonia tristis* Griff) is not uncommon and forms a serious impediment to natural reproduction. Epiphytic figs and climbers are present but, in comparison with what one finds in the deciduous forest of Burma, are negligible."

6. Other types occuring are Mangrove forests, fresh water swamp forests and, on the East Coast, *Casuarina* forests of small extent and importance.

7. *Principal species in evergreen forests.*—By far the greatest number of important tree species in the evergreen forests belong to the Natural Order *Dipterocarpaceae.* This family includes *chengal* (*Balanocarpus Heimii* King), *resak* (*Shorea* spp., in Negri Sambilan usually *Shorea barbata* Brandis) and *kumus* (*Shorea ciliata* King and *S. costata* King) hard, heavy and durable timbers, *kapur* (*Dryobalanops aromatica* Gaertn. f.), lighter but durable, *seraya* (*Shorea Curtisii* Dyer) rather softer, *keruing* (*Dipterocarpus* spp.) the timber of which is not durable but promises well for sleepers etc. after impregnation, and finally *meranti*, a general name given to a number of species of *Shorea* with soft timber. Important timber species belonging to other orders are *merbau* (*Intsia* [*Afzelia*] spp.) with good durable timber; *kempas* (*Koompassia malaccensis* Maing) a very hard timber; *penaga* (*Mesua ferrea* L), *petaling* (*Ochnostachys amentacea* Mast) and *jelutong* (*Dyera* spp.) which produces an ingredient of chewing gum and gives a light soft timber. Owing to the very large

number of tree species in Malaya and the importance in silvicultural operations of recognising the numerous important timber species from a seedling to a giant towering above the lower storeys, a sound botanical knowledge is required by all grades of the staff even more than in Burma.

For silvicultural and exploitation purposes trees are classified as class I and II. Class I includes practically all species known to yield timber of commercial value and is further divided into sub-classes a, b, and c according to the value of the timber. Class II consists mainly of species only suitable for poles and firewood.

Volume of timber per acre.—Dr. Foxworthy has had carried out numerous 1% valuation surveys and his conclusions may be quoted (Proceedings of Forest Conference 1926 [2]):—

"Average good forest in the Peninsula contains from 18 to 25 trees of commercial size per acre and these yield 2085 c. ft. (or 41·7 tons) of timber."

He estimates the present royalty value (fixed on a basis of 10% *ad valorem*) of this timber at $98 (Rs. 146). Of the total volume 75% is composed for Class I timber. The greater portion of this (60% to 65% of the total) is yielded by species of the order Dipterocarpaceae, mainly, *meranti* (soft *Shoreas*) and *keruing* (*Dipterocarpus* spp.) which are estimated to give nearly 50% of the total volume. It should be noted that all trees over 1′ diameter are included in the above figures.

In addition to timber an equal volume of fuel is estimated of a royalty value of about $21 (Rs. 31/8/0) per acre or a total royalty value of $ 119 or Rs. 177/8/0. Dr. Foxworthy "arbitrarily assumes that a yield of 40 tons of timber per acre marks the lower limit of permanent commercial forest". What chance has poor Burma for commercial exploitation with its 12 to 15 tons per acre and a very much higher percentage of what might be called class II timbers!

Development of present methods.—In a paper written for the Malay Forest Conference of 1926 (2) by Mr. A. E. Rambaut, Deputy Conservator of Forests, the development

of the present methods of natural regeneration is traced. I am indebted to this paper for the following information. Up to 1925 the attention of the Malay Forest Department was mainly concentrated on improvement fellings. Improvement fellings in favour of gutta percha were started in 1909 by C. Hummel and the method was extended by him to timber forests in 1910. The necessity of repetition of such fellings was recognised by him prior to Mr. Cubitt's arrival in the country. Mr. Cubitt was the leading exponent of improvement fellings "to be repeated until the desired results have been attained" at the Burma Forest Conference in 1910 and he encouraged work on the same lines when he went to Malaya. At a Forest Conference in 1915 detailed rules were passed for carrying out improvement fellings. Up to this date no trees removed in improvement fellings had been extracted for firewood but at the end of 1915 a consumer was found for the trees girdled in improvement fellings in the Parit reserve. In 1918 in some reserves improvement fellings were marked for firewood extraction and the method was extended to other accessible reserves some of which contained virgin forest. During the course of these fellings, which were originally undertaken purely in the interests of already existing class I trees, profuse natural regeneration of the more valuable species was obtained. In the meantime interesting work had developed in the Kanching reserve in Selangor State. This reserve is the only one on the West Coast drainage which contains *kapur* (*Dryobalanops aromatica* Gaertn f.) in any quantity. It is, therefore, somewhat different from the majority of the reserves on the West Coast. Improvement fellings were commenced in this reserve in 1910. Before the work started "regeneration was very poor, what seedlings there were being suppressed chiefly by *bertam* (*Eugeissonia tristis* Griff), a palm which forms a dense matted undergrowth in parts of the forest and is a serious obstacle to regeneration." As a result of repeated improvement fellings which were admittedly with a view to inducing further regeneration as well as to assist existing class I trees, Mr. Mead reported in 1915 "an even aged forest of practically pure *kapur* saplings about 2500 to 3000 to the acre

has been obtained." Since then cleaning after cleaning has been made and each successive seed year has brought in more regeneration. The cost in the best area up to 1919 was about $13·50 (Rs. 20) per acre. It may be noted that in the case of Kanching reserve the work was all done departmentally. Had the material cut out in the improvement fellings been sold, as it would certainly be nowadays, the revenue from firewood would not have been less than $20 (Rs. 30) per acre.

In another reserve (Bukit Tunggal) a sample plot was made to test various types of improvement fellings, and on one section of this all class II trees and poles were girdled or felled and all creepers and *bertam* were cut in 1916. In 1920 a cleaning showed excellent reproduction of *meranti* (soft *Shorea* spp).

As a result of this experience and in order to regulate the yield of firewood from these fellings, which had become a source of supply to the mines on which the market relied, regular schemes were drawn up to carry on the work systematically.

The following conclusions were drawn by Mr. Rambaut as a result of this work and other observations :—

" 1. That fellings can be so carried out that certain species (most *Dipterocarps* especially) can be assisted at the expense of less valuable species.

" 2. That few species seed every year but usually once in three or four years. On the other hand there is seed of several different species every year. The unwanted species seed more often."

Footnote :—This was Mr. Rambaut's conclusion in 1926 but Dr. Foxworthy has noted as follows :—

" This is hardly a correct generalisation. The following statement is taken from Mal. For. Record, No. 3, page 24—

" *Meranti* has been collected in flower and in fruit during every month of the year. Statements have sometimes been made as to definite intervals between flowering and fruiting times in the different *merantis* ; but, so far as we have been able to ascertain, there is no regular time of year for flowering or fruiting. It may be entirely absent during some years or it may occur more than once within the year. It seems that any prolonged

period of drought followed by a soaking rain may bring trees into flower. Rains are often very local and flowering is also very local. In more than one case, heavy flowering has occurred in one place, when there was none in forest at a distance of five or six miles. It also seems that every year will show some flowering, in some part of the Peninsula, for almost every species.

"The above statement may be applicable to a number of other forms.

"Ridley once published the statement that there is a general fruiting time every six years, but our records show the statement to be incorrect. Our present information gives no warrant for placing any definite limit to the interval between heavy seed years, and the statement once in three or four years is certainly wrong.

"It seems that *meranti*, *keruing*, *chengal*, *kempas*, *marbau*, *jelutong*, *petaling* and *penaga* may be found in fruit practically every year in some part of the Peninsula. *Chengal* seems to produce fruit every year, but I have never known a general fruiting of this form. Sometimes as much as one fifth of the mature trees in a given locality will bear fruit at the same time, but fruiting is usually even more sporadic. Our records show that *kapur* had a general fruiting in the years 1897, 1916, 1920, 1921 and 1926)."

3. Almost all the seed that is not eaten by bats, rats, insects or squirrels germinates but in natural conditions many seedlings fail to establish themselves owing to the depth of undecomposed humus and an enormous number of seedlings die off in the first year either from drip or lack of light.

4. After the seedlings have been established growth is slow and precarious under natural conditions but the rate of growth is greatly increased at almost any age if light is let in.

5. The best regeneration is found in gaps in the canopy about 20′ across; in larger gaps regeneration is not found in the centre. It is obvious, therefore, that until the seedlings are established they require a certain amount of shade.

(To be continued.)

IMPERIAL FORESTRY EDUCATION.

BY R. S. TROUP, C.I.E., D.SC., F.R.S.,

Director, Imperial Forestry Institute, Oxford.

[Paper presented to the third British Empire Forestry Conference held in Australia and New Zealand, 1928.]

INTRODUCTION.

The future progress of forestry in the Empire must depend to a very large extent on the calibre of the recruits obtained for the forest services and the quality of the professional training which they receive. Successful results must depend primarily on a sound educational policy; it will be for the Conference to consider whether or not the policy at present in force is likely to achieve the best results, and to indicate, if necessary, in what respects matters may be improved.

At the present stage of forest educational development it is natural that discussion should centre largely round the Imperial Forestry Institute, which was created as a result of recommendations made by the first two British Empire Forestry Conferences. The experience gained since the Institute was started has been invaluable in revealing the merits and defects of its scheme of organization and in indicating the lines on which future development should proceed. It is proposed, therefore, to give the Conference of 1928 a brief account of the progress made so far on the educational side, mentioning some of the difficulties which have been encountered, and to offer certain suggestions for increasing the efficiency of the forest services in the future. It is hoped that this will draw useful criticisms and lead to discussions which will be of value in determining questions of future policy in regard not only to the Institute in particular, but also to the Empire in general.

It would be well here to draw a clear distinction, already recognized by previous Conferences, between the full training required by officers of the higher branches of the forest services or for large forestry undertakings and the more simple form of training required for the management of private woodlands, often

in addition to other estate duties. Important though the latter is in its right place, it should be emphasised that we are concerned here only with the former class of training.

ESTABLISHMENT OF THE IMPERIAL FORESTRY INSTITUTE.

A perusal of the proceedings of the first two British Empire Forestry Conferences will show that the necessity for improving the standard of training for the forest services has already been fully realised. With the object of placing matters on a more satisfactory footing the Conference of 1920 recommended the establishment in the United Kingdom of a central institution which should undertake the higher training of forest officers for the Empire, and should also be a centre of research into the formation, tending and protection of forests. An Interdepartmental Committee appointed to make proposals on this basis recommended the establishment at Oxford of a central institution for the higher training of forest officers, for the provision of special and "refresher" courses for officers already serving, and for the conduct of research into problems of forest production. The Conference of 1923 strongly supported this recommendation, and its views were endorsed by the Imperial Economic Conference held in London the same year. As a consequence the Imperial Forestry Institute was established at Oxford in 1924, and commenced work in October of that year.

Attendance at the Institute.—During the first four years the attendance at the Institute has averaged 30 students a year, apart from special research workers and students averaging 6 a year. This may be classified as follows :—

	1924-5.	1925-6.	1926-7.	1927-8.	Total 4 years.
Post-graduate probationers :					
Great Britain	1	...	1	1	3
Colonial Services	10	9	6	9	34
Indian Services	...	5	3	...	8
South Africa Service ...	...	...	2	3	5
Total ...	11	14	12	13	50

	1924-5.	1925-6.	1926-7.	1927-8.	Total 4 years.
Forest Officers on leave:					
Colonial Services ...	7	14	14	12	47
Indian Services	1	9	2	2	14
Total ...	8	23	16	14	61
Private Students	...	2	4	2	8
Grand Total ...	19	39	32	29	119
Special research workers and students	3	5	9	9	...

Courses of Study.—Details are given in the Prospectus of the Institute. It will be convenient to consider the courses of study separately in regard to (I) post-graduate training (2) "refresher" courses, and (3) special courses.

(1) *Post-graduate training.*—The lines of training vary according to the needs of the individual, taking into account his past-training and the country in which he is to serve. Students destined for service in the tropical colonies are given special courses in tropical silviculture, in the systematic botany of the regions to which they are proceeding, and in other branches of work suited to their requirements. The study of silvicultural systems, forest management, and methods of extraction, transport and utilisation, is in every case carried out practically during tours on the Continent of Europe. Students are also encouraged, when it is desirable and so far as time permits, to take up the study of special subjects in which they are interested.

(2) "*Refresher*" *Courses.*—These have been largely attended by forest officers on leave, the subjects most commonly studied being silvicultural systems, forest management, mensuration and reconnaissance, the systematic botany of particular regions and tropical silviculture; some officers have taken courses of surveying and other special work. The practical study of the latest European systems of silviculture and forest management appeals particularly to the forest officer on leave; the organisation of tours on the Continent is, therefore, among the most important functions

of the Institute, and advantage of the facilities provided has already been taken by a large number of officers.

(3) *Special Courses.*—The importance of specialisation has already come to be realised in some colonies, which have deputed officers to the Institute to undergo courses of specialised training. An officer from the Federated Malay States has undergone a special course in the structure and identification of woods. Two officers from Nigeria and one from the Gold Coast have undergone special training in silvicultural research methods, in order to start research work in their respective colonies. In the case of the officers from Nigeria, arrangements were made through the Inspector General of Forests, India, for a visit to India and Burma in order to see some of the latest developments in tropical silviculture ; the experience gained during this visit should prove of great benefit to Nigeria. Two other officers from Nigeria have been deputed for special training in utilisation and in the seasoning of timber, and are now undergoing training partly at the Institute and partly at the Forest Products Laboratory, Princes Risborough. These may be quoted as instances in which the Institute, in addition to providing direct instruction, may be of service in arranging instruction at other centres or visits to countries where special problems may best be studied. In connection with the study of systematic botany of particular regions, valuable assistance has been provided by the Royal Botanic Gardens, Kew, at which several students of the Institute have put in short supplementary periods of study under the guidance of the Institute staff.

DEVELOPMENT AND EQUIPMENT OF THE INSTITUTE.

The development of the Institute has not been unattended by serious difficulties, some of which have not yet been surmounted. When it started work in October, 1924, it had the advantage of certain facilities afforded by the School of Forestry at Oxford, in the shape of a nucleus staff, lecture rooms and laboratories, a good forestry library, a reference system already established and in running order, a museum, a wood collection fairly complete in certain directions, deficient in others, an experimental nursery and demonstration area, and a good organisation of Continental

tours. On the other hand there was no herbarium suitable for the training of tropical probationers, only very elementary facilities for the microscopic study of woods and for microphotography, no good collection of microscope slides of woods or of microphotographs; the zoological, mycological and other collections, though suitable for the requirements of a general training, were insufficient for the needs of specialised training. The building up of a suitable staff has in itself presented numerous difficulties, which have not yet been fully overcome, and as this question is of special concern in regard to any training centre, it will be referred to later.

The most serious handicap to progress has been the lack of accommodation. The School of Forestry building had already proved inadequate to the expanding needs of that institution alone; with the addition of a new institution with its staff, students and equipment, the position during the first year was one of great difficulty. For the time being the situation has been met in part by the erection of a temporary laboratory and work rooms, and the purchase and temporary equipment of two houses in the vicinity of the School of Forestry. For this purpose it has been necessary to divert funds amounting in all to over £6,000 which were earmarked for staff and permanent equipment, and this has proved to be a serious drain on the resources of the Institute and a handicap to its development.

In spite of these difficulties the progress made so far has been encouraging; full details will be found in the Annual Reports of the Institute, and need not be given here. Thanks to the cooperation of forest officers and others throughout the Empire, the Institute now possesses a teaching herbarium, which, in the beginning of this year, numbered over 15,000 specimens representative of many different regions. The wood collection has been greatly increased; a large type collection of microscope slides has been built up, and the equipment for microphotographic work is said to be unsurpassed in Great Britain if not in Europe. Numerous additions have been made to the library, and the reference system has been greatly developed. The zoological, mycological, and other collections have been increased to such an extent that many

of them, for want of space, have to be stored instead of displayed. A new experimental garden has been established, in co-operation with the Forestry Commission, within two miles of the Institute, and here training is given in methods of silvicultural experiment having direct application to practice.

The future progress of the Institute must now depend primarily on the provision of a suitable building. Estimates prepared three years ago showed that a sum of not less than £75,000 would be required, but experience gained since then indicates that this sum is likely to be inadequate, and it would be safer to place the estimated cost at £100,000. A building fund has been started, and so far a sum of about £6,000 has been received or promised, of which the bulk has been contributed by the Rhodes Trustees. But the time has now come when the provision of a suitable building cannot be longer delayed if the Institute is to prove a success, and it is hoped that the Conference will give this matter its earnest consideration.

STAFF AND TEACHING.

The success of any training centre must depend to a very large extent on the qualifications and capabilities of the staff. This is a question requiring consideration from the general point of view, and not with special reference to the Institute. The first point to be emphasised is that if fully qualified and efficient teachers are to be obtained, the terms offered should be sufficient to attract and retain the best men available. The efficiency of the forest services will depend so largely on the manner in which their officers are trained, that cheapness in regard to the teaching staff is the worst form of false economy.

So far as the qualifications and strength of the staff is concerned, it should be remembered first, that forestry comprises a number of different branches of work, in which our knowledge is rapidly advancing, each branch being more or less specialised, but all being interdependent; second, that it is essentially a practical subject and should be taught as such. Hence, if a comprehensive and up-to-date training is to be given, a numerically strong staff is necessary, the individual members of which should have a suffi-

cient knowledge of all the branches and a specialised knowledge of the branch or branches in which they are to instruct. It is important also that each member of the staff should have ample opportunity of keeping up to-date by studying the results obtained by others and by carrying out research himself. In this way originality is introduced into the teaching, and the latest knowledge is imparted. With a numerically weak staff this is impossible, and there is a danger of the teaching degenerating into what is virtually the reading aloud by a lecturer insufficiently acquainted with his subject, of excerpts hurriedly gleaned from text-books, which are often out-of-date, while practical instruction, which is the most important part of the training, is apt to be neglected. For this reason the most elaborate paper curriculum may convey little meaning as to the actual value of the training given.

In order that the teaching and research staff, as well as students, should have the latest information readily available, a good library and reference system are essential, and these should be kept constantly up-to-date. The library should include all important periodicals, reports and other literature bearing on forestry. The number of these is extensive; the Imperial Forestry Institute takes in over 70 current periodicals alone apart from bulletins, reports and other publications, and it possesses complete sets of periodicals, the back numbers of some of which are now unobtainable. All these publications are gone through and referenced, so that the latest information is available for teaching and research purposes in the various branches of forestry.

Turning to the question of personnel, in order to secure the best results it is advisable that even for the most specialised forestry subjects, such as forest entomology, and mycology the lecturer should have had a good general training in forestry apart from his specialised training, and preferably also some experience of actual work in the forest; without such qualifications he cannot fully appreciate the difficulties encountered by the forester in applying theory to practice. In the case of silviculture, forest management, utilisation, policy and economics, the lecturer should have had not only a complete training in forestry, but also a good deal of

practical experience in the management of forests and the handling of timber operations; without such experience his teaching must inevitably be theoretical and academic. It goes without saying that no teacher of forest management can be considered to be fully qualified for his post unless he has had practical experience in the preparation of working plans and the management of organised forests worked under the prescriptions of working plans.

The question of language qualifications is an important one. So much forest literature is published in French and German, that a sufficient knowledge of these languages may be regarded as essential for any lecturer who is to keep abreast of the times. The practical study of scientific systems of forestry on the Continent of Europe may be regarded as a necessary part of a good training in forestry, and lecturers who have charge of parties undergoing practical instruction on the Continent should have a good knowledge of French and German.

The question of maintaining continuity of work is at times a difficult one, particularly in the more specialised branches of forestry, in which the number of competent teachers available to fill temporary or permanent vacancies is decidedly limited. In connection with the Imperial Forestry Institute it has been suggested that forest officers should be lent from time to time to act as lecturers for a limited period. In certain cases this might be advantageous, provided officers could be lent for a sufficiently long time to ensure continuity. As a general procedure the more satisfactory alternative would be to appoint understudies, particularly in those branches of work in which vacancies cannot be readily filled from outside; these understudies could be usefully employed partly to assist in teaching and partly to carry out research.

An organisation of staff and teaching such as has just been outlined would involve expenditure considerably in excess of that to which we are accustomed in our training centres, at all events in Great Britain. It might, therefore, be inferred that the ideas which have been put forward are extravagant; the more correct conclusion to be drawn, however, would be that our training

centres are inadequately staffed and organised, and that hitherto requirements in this respect have not been fully appreciated.

RECRUITMENT.

The question of training for the forest services cannot well be dissociated from that of recruitment. The best training in the world will not convert unsuitable material into good forest officers hence there is a great advantage in selecting recruits provisionally before they undergo their training in forestry, and guaranteeing them posts on satisfactorily completing it. This principle has always been recognised in recruiting for the Indian Forest Service; it is also in force for the South African Service and the newly formed Burma Service. It does not necessarily follow that every recruit obtained in this way will turn out a first-class officer, but the chances of excluding the unfit are greatly strengthened. Many promising men who would be prepared to enter one of the forest services decline to face the expense of a training without some guarantee of a post at the end of it; on the other hand, not a few men who would be excluded at a preliminary selection as unsuitable actually undergo their training and enter the services because of the lack of better recruits.

CONTINENTAL TOURS.

No scheme of training can be considered complete unless it makes sufficient provision for the practical study of silvicultural systems and detailed operations of various kinds on the Continent of Europe, where the systematic management of forests has been in force for centuries. The objection may be raised that the systems of continental Europe are not applicable under the widely differing conditions met with in many parts of the British Empire. Perhaps the best answer to this is to state that the great progress which forestry has made in India has been due in no small measure to the fact that practical work on the Continent of Europe has always formed an important part of the training given to recruits for the Indian Forest Service, and the systems of Europe are now applied, with suitable modifications, under widely varying conditions throughout India. The practical study of European systems does not imply that they should be followed

slavishly under all conditions, but an intelligent forest officer who has been well grounded in the principles exemplified in continental Europe will not fail to appreciate the great advantage which he possesses when he is faced with his own problems. For this reason not only should every recruit for the forest services be well grounded in the practical side of continental European forestry, but forest officers should endeavour to revisit the forests of Europe at least once during the course of their service, in order to bring their knowledge up-to-date. This is now rendered easier than it was at one time, owing to the regular organisation of continental tours by the Imperial Forestry Institute. In this respect the Institute can be of considerable service to overseas training centres, in providing facilities for the practical study of forestry on the Continent of Europe to students who have had no opportunity for such study during their course of training.

The importance of the Institute as a means of providing for the study of continental systems was fully realised by the Forestry Sub-Committee of the Imperial Conference held in London in 1926, as will be seen from the following extract:—

> "The Sub-Committee . . . . particularly desire to draw attention to the opportunities which are afforded foresters from overseas to study in and from this Institute the results of long-established scientific management in European forests."

Experience of the first four years of the Imperial Forestry Institute.—So far as the provision of "refresher" and special courses is concerned, the experience of the first four years has shown that if the difficulty as regards accommodation can be overcome the Institute should justify expectations in every way and become the vital factor in the advance of forestry in the Empire. In addition, it should be able to provide valuable assistance to overseas training centres in the direction just mentioned.

So far as the post-graduate training of probationers for the British and Colonial services is concerned, the idea of bringing all probationers together at one centre before they begin their service is an excellent one in principle. The probationers are given a special training in subjects fitting them for service in their own

particular regions, which cannot well be given in a general course of training. But equally advantageous is the fact that a most desirable *esprit de corps* is fostered, since the probationers are brought into touch, not only with each other, but also with officers on leave from various parts of the Empire. They also come into touch with probationers for the administrative services undergoing courses of training at Oxford, coming into social contact with them in a Colonial Services Club. There is probably no centre better calculated to foster the spirit of service to the Empire than that University, associated as it is with the name of Cecil Rhodes and his great scheme of Rhodes Scholarships, which brings together many of the best representatives of young manhood from overseas.

The year's post-graduate training at the Institute should therefore prove of great benefit to the probationers and to the forest services generally. The advantages to be derived from an advanced training, however, will not be secured unless the calibre of the students is sufficiently high, and unless they have already received a general training sufficiently thorough to enable them to profit by the more advanced and specialised training given at the Institute. Experience so far has revealed certain deficiencies in these respects which could be removed, to some extent at least, by recruitment on the lines suggested above, and by greater insistence on a high standard of general training. In certain instances backward students have been sent to the Institute mainly for the purpose of being coached up in elementary subjects in which they have been found deficient. This not only wastes much of the time of the staff, but also calls on the Institute to perform, functions for which it was never intended; it is hoped, therefore, that the authorities who depute students to the Institute will in future take such precautions as may be necessary to exclude the unfit.

SUMMARY.

The chief points which this paper endeavours to bring out may be summarised as follows:—

(1) A sound educational policy is essential to the future progress of forestry in the Empire; in framing such a policy

a distinction should be drawn between the full training required for the forest services and for large undertakings, and the simpler training required for the management of private woodlands in conjunction with other estate duties; the present paper deals only with the former.

(2) The Imperial Forestry Institute, created on the recommendations of the two previous Conferences, started work in 1924; although handicapped by lack of accommodation it has made encouraging progress, but its future success must depend primarily on the provision of a suitable building, the cost which is estimated at £100,000.

(3) The system of recruitment before instead of after training, which is in force for some forest services, should be extended to the forest services generally.

(4) The practical study of silvicultural systems and various operations on the Continent of Europe may be considered to be an essential part of a complete training in forestry; in the organisation of tours for this purpose the Imperial Forestry Institute can be of material assistance to overseas training centres as well as to forest officers already serving.

(5) The experience of the first four years has shown that the Imperial Forestry Institute, if provided with suitable buildings, should become a vital factor in the advance of forestry in the Empire; this refers to "refresher" and special courses as well as to post-graduate probationary courses, though in the latter case the benefits secured by attending the Institute must depend largely on the calibre of the students and on the standard of their general training.

PRIZE DAY AT THE FOREST COLLEGE, DEHRA DUN.

The annual prize-giving at the Forest College, Dehra Dun, was held on 28th March 1929. The following speech was made by Mr. Rodger, the Inspector General of Forests:—

"The Ranger students who are now leaving the College are the first who entered after passing the qualifying examination

after we revived this very useful institution, and it is satisfactory to say that the general level attained by these students is high. The whole class of 15 have obtained Higher Standard Certificates except one, and the marks obtained are generally good, although there is nothing of outstanding merit to note. Again, however, we can congratulate Kashmir on taking a number of good places on the list and on carrying off more than half the prizes. Fourteen Higher Standard Certificates have been allotted; Kashmir has taken no less than six of these, so that we have every reason to be pleased that this State sends so many students to Dehra Dun. The prizes have been allotted as follows:—

1. Silver Medal for Forestry ...	M. N. Pait.	Assam.
2. Silver Medal for Botany ...	R. K. Kou	Kashmir.
3. Silver Medal for Engineering ...	P. N. Koul.	Kashmir.
4. Fernandez Medal for Utilisation	R. K. Koul.	Kashmir.
5. McDonnel Medal for best Punjab or Kashmir student ...	R. K. Koul.	Kashmir.
6. William Prothero Thomas Prize for best practical Forester ...	Ganpat Rai.	Private.
7. "Indian Forester" Prize for best student with no other prize ...	A. N. Gupta.	Kashmir.

"I cannot speak very highly about the athletic prowess of the outgoing class as they have been very moderate in games and sports, and I would like to say, as I did last year, that I think it is most important that all the students should take an interest in the College games and sports and that something a little more manly than Badminton should be expected from young forest officers.

"The students have kept good health, with the exception of one case of appendicitis, and one accident to a leg when practising for sports. Unfortunately the student who was injured in this way has not been able to attend the College tours and lectures for some time.

"The students as usual did a great deal of practical work in the sal and coniferous forests of the United Provinces and our

thanks are due to the following Divisional Officers for their kindness in arranging tours and in helping in the instruction of the class in their Divisions :—

Messrs. Howard, Hall, Bailey, Marriott, Hopkins and Tula Ram.

"Once again I want to say to you that we value the forest officer who is a practical man more than any other. Students who come to us from Indian Schools and Universities are apt to depend too much on the written word and I can assure that there is nothing so unsuitable and so unlikely to assist in producing a good forest officer.

"You must try and live in your jungles as much as you can and get to know them thoroughly. Sitting in an office and merely issuing orders is the worst thing a forest officer can do, and even in the highest grades he can do more good work in the forest than he can in his office.

"Last year I appealed to the outgoing students to remember our old established paper the *Indian Forester* and I hope that you will all give your best support to this magazine. We shall be glad to have articles and photographs dealing with forest matters from any part of India and we should like you to try and help to keep up this journal, which is now in its 53rd year.

"To Mr. Trevor and to all Lecturers, Instructors and Assistants, and to the staff of the Forest Research Institute I wish to express my heartiest thanks for the trouble they have taken in the training of the students.

"I know you will join me in wishing Mr. Trevor a good time at home during his leave, after being with us for 2½ years, and doing so much for both Colleges. We shall find it very hard to replace him.

"I give to all the outgoing students the best wishes of the staff for their future careers and for an enjoyable life in the Forest Department. Certificates for Rangers have been given here every year for the last 48 years. I have now much pleasure in distributing the certificates and prizes."

The following is the list of the students who obtained the certificates :—

HIGHER STANDARD CERTIFICATES.

Order of Merit.

1. R. K. Koul	...	...	Kashmir.
2. Ganpat Rai	...	...	Private.
3. M. N. Paitt	...	...	Assam.
4. A. N. Gupta	...	...	Kashmir.
5. B. C. Nandi	...	...	Assam.
6. P. N. Koul	...	...	Kashmir.
7. Jiwan Singh	...	...	Mandi.
8. B. D. Barua	...	...	Assam.
9. A. R. Manhas	...	...	Kashmir.
10. B. N. Razdan	...	...	"
11. J. S. Mathur	...	...	Alwar.
12. Gopal Singh	...	...	Bharatpur.
13. M. R. Sharma	...	...	Kashmir.
14. E. Joseph	...	...	Andamans.

LOWER STANDARD CERTIFICATE.

15. Niranjan Lal	...	...	Andamans.

NATURAL DIARRHOEA IN ELEPHANTS.

As diarrhœa in elephants is of considerable interest to the profession and of some consequence to the animal and the owner I put the following observations before the readers of this esteemed Journal.

The heading " Natural Diarrhœa " is selected as it is natural with the elephants to purge at intervals and as it is more physiological and desirable than pathological.

This diarrhœa as in any other form is characterised by increased frequency of softer and watery evacuations of the contents of the alimentary canal.

It occurs throughout the year, in all seasons and wherever the elephants are found whether in captivity or in the natural wild state and whether stall fed or left to graze at large. It is seen in healthy and sickly ones of all ages and sexes.

The question why it should occur is satisfactorily answered only if the causes and consequences are unreservedly dealt with. The immediate cause is eating selected earth and the consequence a temporary weakness of the digestive and the general system involving a loss of a week's work. It is still questionable why an elephant should eat earth and purge instinctively and for what purpose. The apparent symptoms that precede and follow diarrhœa in the animal reveal why and when an elephant eats earth. The animal suddenly appears slightly dull and indisposed. It is followed by mild flatulency of the alimentary system. He is not inclined to eat his rations or fodder as usual. He then searches for and eats the bark of *jala* (*Shorea Talura*) *mathi* (*Terminalia tomentosa*) and *seege* creeper (*Acacia concinna*). He is in this state from about 6 to 12 hours. He then goes about and eats this selected earth up to, I think, about 10 lbs or more. (Some also eat bark after eating earth). He begins to purge after 8 to 15 hours, purging for about a day or two. Considering the number of parasites that infest an elephant's digestive system this healthy habit of the elephant to rid itself of the contents of the alimentary canal can be made use of by the Veterinary Surgeon in furthur assisting nature. The purgative taken is sufficient requiring no adjunct or corrective. *Jala* and *mathi* barks are astringents and vermicides and *seege* is a vermicide. Elephants in captivity are domesticated and require some stronger vermifuges or vermicides. These are best given when the elephant eats its natural vermicide and before it takes its purgative, so that the vermicide will have sufficient time to act. My revered teacher Mr. F. X. Mascranhas, G. B. V. C., administered santonine when the animal started purging. I think it is preferable to do it earlier as in some animals purgation stops in about 6 to 10 hours. If instructions are given, the mahouts will ask for the worm powder when they see the animal eating these barks. Questioning deeper still one would ask why elephants alone should have this advantage over other animals in creation. The simple answer that it is natural, is insufficient. We do find some solution in the mode of their natural living. They love grass but more still the roots

of some variety of grasses. Again when they twist and pull up grass with their trunks they are pulled out with root and all. This they dash on their feet and eat along with the remaining earth, dirt, eggs of parasites, dried leaves etc. Sometimes they do throw away the roots. The quantity of these indigestible materials they consume daily is considerable. Some of the tree fodder they naturally eat is very coarse. The stomach is comparatively small. I had in the first post mortem examination I held, to search for the stomach. The liver is not comparatively big. The pancreas is. To make good these discrepancies, and to remove the evil effects of the rubbish eaten daily nature provides that when the necessity arises the animal administers a purge to itself as a corrective.

The presence of bots, round worms, flukes etc. in the digestive system of elephants has led some to believe that these worms are the cause of the irritation which causes elephants to eat earth and purge. No author appears to have noted the condition of the animal preceding diarrhœa which I think is important. Mr. F. Ware, F. R. C. V. S., then Superintendent, Civil Veterinary Department, Madras, instructed me in 1914 to find out whether worms cause this diarrhœa or come out as a consequence. My observation is that they are thrown out as a consequence, 90 per cent. being killed. I have seen often in severe cases of this diarrhœa no worms being passed. I do not think that worms can be the cause of this mild flatulency at regular and irregular intervals, in all seasons and in all elephants kept under various conditions.

In the post mortem examinations of carcasses of elephants destroyed, dead, and shot for sport one will invariably find number of patches of congestion, inflammation, and even ulceration on the walls of the stomach and intestines revealing that coarse and adulterated fodder though consumed instinctively does interfere with the digestive canal. The number of worms found in all cannot be made responsible for this.

This state of the alimentary canal suggests that frequent administration of oleaginous preparations much advocated by native mahouts are useful.

A complete change of environment such as locality, climatic conditions, grass and tree fodder checks this diarrhœa for a considerable time. I have noticed animals that usually purged once in three or four months having no attack of diarrhœa for over 8 months under a new environment.

PATHOLOGY IN PHYSIOLOGICAL DIARRHŒA.

An interval of three to four months between these attacks is I think desirable. But if the interval is shorter the elephant gets thinner and weaker requiring interference. In such cases a complete change of rations is indicated. In persistant cases Liquor arsenicalis, vegetables, bitters, and Ferri sulphas answer well. If, howèver, the elephant fails to improve by the above treatment in about six months, the following *massal* is worth its cost :—

Ghee	..	...	... 8 oz.
Beaten rice	...	...	... 3 lbs.
Jaggery	...	..	... 10 oz.
Cocoanuts	...	...	... 2 (kernel only).
Omum seeds	...	...	... 2 oz.
Onions	...	...	... 4 oz.

Crush and mix all together and give daily once for one month.

Bathing, working and grain feeding them during this period is very harmful.

A. B. BOPAYYA, G. M. V. C.,
Veterinary Assistant Surgeon,
Coorg Forest Department.

FOREST FLORA OF THE CHAKRATA, DEHRA DUN AND SAHARANPUR FOREST DIVISIONS, THIRD EDITION, REVISED

BY BASANT LAL GUPTA, M.Sc., F.L.S. PRICE Rs. 3/3.

This is the third edition of the Forest Flora of the School Circle originally prepared by the late Rai Bahadur Upendranath Kanjilal in 1901. The flora was especially designed for the use of students at Dehra Dun and it has served its purpose well as every forest officer who has passed through the College during the past 30 years could testify. A fresh edition is, therefore, of more than passing interest to readers of the "Indian Forester."

In the preface Mr. R. N. Parker refers to the many changes in nomenclature, but adds that such alterations have not been introduced unnecessarily. Nevertheless, there are many well known plants the names of which have had to be changed. For instance Berberis nepalensis, *Spreng.* is now Mahonia nepaulensis,

D. C. and Odina Wodier, *Roxb.* is Lannea grandis, *Engl.* whilst Mitragyna parvifolia, *Korth.* takes the place of Stephegyne parvifolia, *Korth.* and Woodfordia fruticosa, *Kurz.* is substituted for W. floribunda, *Salisb.*

In the new edition the number of species described has been greatly increased and the work has been brought up-to-date in a number of ways. It is particularly pleasing to note that many conspicuous or common garden plants not mentioned in previous editions have been added, such as Kigelia pinnata, *D.C.* Jacaranda ovalifolia, *R. Br.*, Petrea volubills, *Linn.*, Bignonia venusta, *Ker. Gawl.* and Bougainvillæa spectabilis, *Wild.* which will make the book useful to many who are neither foresters nor botanists.

Besides a great increase in the number of species described in full, many new herbs are also mentioned in small type. For instance eleven species of Ipomæa including the beautiful "morning glory" and one or two other American species which have run wild. In fact, a brief study of this little volume shows at once to what an amazing extent plants indigenous to tropical America have become naturalised in the Dun. In this connection the American pest Lantana Camara, *Linn.* will not be forgotten

The author has not restricted himself entirely to describing woody plants, as has been done in some recent local floras. The book is, however, largely if not mainly intended as a text book for the use of students and for this reason it is very convenient to have the more conspicuous herbs included and the course adopted seems justified. On the other hand it is not clear why Spirœa vaccinifolia, *Don.* has not been described in full when S. bella, *Sims.* which is as a rule slightly smaller is described. The same criticism applies to Flemingia paniculata, *Wall.* and F. bracteata, *Wt.* of which only the latter is described in full.

The new edition still continues to call Vitis latifolia, *Roxb.* a large climber, wherein the author seems to be confusing this species with V. repanda, *W. and A.* Again, the distribution of Caryopteris grata, *Benth.* is given as Jaunsar and Tehri Garhwal up to 5,000′. This seems incorrect as its normal habitat in the adjoining Kumaon hills is banj oak forest between 5,500 and

7,000′ though like many another plant of the oak zone it is also found in swamps in the Dun at 1,200′ elevation, as for instance at Gola Tappar.

Most forest officers will agree with the author in separating the high-level and low-level silver firs as distinct species.

Under Gardenia turgida, *Roxb.* we read that "according to certain observers if one places one's hands on the stem of this tree in the summer so as to encircle it, the leaves begin to shake." In the second edition the observer was given by name. It seems a pity that the new author did not verify the truth or otherwise of this observation himself considering the tree is tolerably common in the Siwaliks. The writer has never succeeded in reproducing the alleged phenomenon, but then it must in all fairness be added that the planchette is equally intractible in his unskilled hands.

A few omissions were noticed. Rubiaceæ is absent from the index and the species on page 389 have not been serially numbered. The author is, however, to be congratulated on the result which is a great improvement on past editions.

A. E. O.

FOUNDATIONS OF SILVICULTURE UPON AN ECOLOGICAL BASIS.

BY J. W. TOUMEY, PROFESSOR OF SILVICULTURE, YALE.
LONDON, CHAPMAN AND HALL, PRICE 20 SHILLINGS.

Professor Toumey's previous book "Seeding and Planting" is well known to forest officers and we have found it of much use in our educational work. It is, therefore, with much interest that we turn to this new book which considers various aspects of silviculture from an angle different from the usual one. The author approaches his subject from the standpoint of the causes which bring certain forest types into existence, a matter which year by year becomes of more importance in forestry, and every forester must recognise the vast difference between the "Ay sticking in a tree" type of forestry with that founded on the natural and scientific basis of Cajander's "Theory of Forest Types".

Forest vegetation is composed of plant communities or units of vegetation, developed and arranged in accordance with definite biological laws and is not an aggregation of trees and other plants brought together by chance and forestry is more and more tending to this view. As we conceive it to-day silviculture is not an outgrowth of plant ecology, but rather plant ecology is an outgrowth of silviculture and whenever the ecologist goes to work in a forest he finds that much has already been done by the silviculturist. The author discusses the various influences of the site and climatic factors on vegetation and the reaction of forest vegetation on the site factors. In Part II he deals with forest vegetational units and their classification and the life history of forest communities and the theory of succession. The author has taken an immense amount of trouble in collecting information on innumerable points which are constantly cropping up in forestry such as the problems of natural reproduction, the development of epicormic branches, the effect of thinnings, the factors influencing the development of bole etc. etc. The book is well worth reading by those who are interested in the latest developments connected with forest types and plant succession.

C. G. T.

EXTRACTS.

FORESTS IN CENTRAL PROVINCES.

ENQUIRY COMMITTEE.

In pursuance of an undertaking given in the Legislative Council, the Governor in Council has decided to appoint a committee of the members of the Legislative Council, to examine and report on the questions connected with the administration of the Forest Department, such as the adequacy of existing facilities to agriculturists in the matter of obtaining their requirements in the way of fodder, fuel, thatching grass, poles etc. at reasonable rates; the development of forest industries; the classification

of the reserved forests in the light of the recommendations of the Royal Commission on Agriculture; the adequacy of the existing grazing rates; the simplification of the grazing rules and suggestions for their better administration.

FORESTS AN IMPERIAL TREASURE.

Imagination—conjuring up visions of vast silent tracts of untold wealth—a Spirit of Enterprise with its irresistible appeal to Youth—wooing the Pioneer to the glorious adventure of seeking out this Treasure for the Imperial weal—Forethought—leading us so to maintain and develop existing forests and *create new* Forest tracts that today's saplings may in time become sturdy witnesses to the wisdom of our age: these are the dominating factors which led to the formation of the *Empire Forestry Association* and to its incorporation under Royal Charter by His Majesty the King in Council.

At a time when public interest finds itself focussed upon the immense natural and industrial resources of the British Empire, no issue can vie in importance with the consideration of the present and potential revenue hidden in the depths of our Empire Forests. These vast acreages of forest land scattered over the length and breadth of the Empire stand as sources of Wealth from which a thousand and one Industrial Interests may draw material which, in one form or another, is essentially vital to the requirements of modern commercial enterprise.

Many tides have ebbed and flowed since they who would go down to the sea for war or commerce must first go to the forest for timber with which to build their ships. And yet in spite of the enormous revolution effected by the introduction of iron—steel—concrete—electric power and other discoveries, which are now commonplace, Timber with its illimitable uses remains, and must remain, one of the greatest of all natural assets, indispensable to world progress.

In this fact lies the urgent necessity for some definite plan for conserving existing and organising new Empire Timber supplies so as to combat the inevitable timber famine of the future.

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For, unlike manufactured material, timber cannot be immediately produced to meet the old and new uses for which it is required. It is a question of years—of slow, steady growth and careful tending from the sapling to the forest giant. Every inroad upon existing timber must be made good *now*.

Not only is the re-stocking of existing forest areas essential, there is also the urgent task of literally creating *New Forests*, thereby laying the foundations of *New Sources of Timber Supply*, on the thousands upon thousands of acres of otherwise non-productive land. This land may be made to provide, under expert management, a harvest of timber which will assure adequate supplies for generations *if planted* NOW.

The *Empire Forestry Association* regard their work as an imperative duty to the British Empire. It is in the furtherance of this difficult and highly technical project that all are invited to aid the Association with their practical support. In this way and in this way only can we guarantee for posterity these Treasures of the Empire and meet the present day demands.

Everyone is aware of the unprecedented demand for timber during the great war, to meet which huge areas of valuable forest were literally destroyed.

This necessary yet nevertheless ruthless devastation was carried on with the same lavish disregard for future consequences that characterised so many of our activities during the strenuous years of 1914-18. Thus we are left to-day with the serious consideration of the necessity to repay our debt to Nature by systematic forest management, by promoting forest conservation, re-planting with all possible speed the denuded areas, and the creation of new areas of forests.

With this object in view an Empire Forestry Conference was convened in London under Government auspices in 1920, and it is to a resolution passed at that Conference that the *Empire Forestry Association*, founded in 1921, owes its origin.

With its incorporation by Royal Charter and under the direct Patronage of H. M. King George V., and under the Presidency of H. R. H. The Prince of Wales, the Association, supported by a

strong and influential Governing Council, commenced a work which may be said to have fully justified its inception, and has gathered within its membership important representatives of Forestry Interests from every part of the Empire.

The *Empire Forestry Association*, working in close conjunction with the Advisory Committee on Empire timbers of the Imperial Institute, and with the practical assistance upon its Council of members of the Timber Trades Federation, has established itself as an important and much-needed "clearing-house" for all information respecting forestry matters in general and the timbers of the Empire.

After seven years of successful pioneer work in bringing together the interests of those Departments and organisations in the Empire as well as individuals intimately concerned in its object, the Governing Council of the Association feel that the membership should be greatly increased.

For it is now apparent to those most intimately connected with the work of the Association since its inception that its future activities must embrace many new aspects of Forestry. These new calls have gradually and very naturally arisen as the practical methods for assisting the cause of Empire Forestry have become more widely known and appreciated.

These developments have until now been restricted by lack of adequate financial support.

With a view to extending the power and usefulness of the Association the Council now appeal to all whose professional or business interests are bound up with the development of the timber industry or any branch of forestry and also to those to whom every phase of Empire Development is a matter of personal interest, to become members of the Association. Indeed it would be difficult to suggest any section of the community to whom the information concerning our Empire Forests contained in the literature supplied by the Association does not make a direct appeal.

One important aspect of the Association's work which has been greatly handicapped by lack of financial support is the publication of the *Empire Forestry Journal.*

This journal is the vital link in the chain of the Association's interests. It is the means of communication between the widely scattered forest services and contains a wealth of general forestry information in the form of technical notes, technical and descriptive articles and reviews of forestry literature.

At present, owing to lack of funds, the Journal is restricted to two numbers each year, sent free to members, but also available to non-members at 7/6 net each number.

To fulfil adequately its important mission this Journal should be published at least four times a year, and it is hoped that a generous response to this appeal will enable this ideal to become an accomplished fact in the near future.

In addition the Association welcomes any technical enquiries respecting either the production or exploitation of Empire Timbers.

(*Empire Forestry Association.*)

DEFORESTED AMERICA.

BY MAJOR GEORGE P. AHERN (WASHINGTON, D. C., 1928.)

For the last decade and more the essential fact about the forest situation in America has been winked at or overlooked in most public discussions of the subject. This fact is that our forests are disappearing at a rate that involves most serious danger to the future prosperity of our country, and that little or nothing that counts is being done about it.

Out of 822,000,000 acres of virgin forest only about one-eighth remains. Half of that remainder, roughly speaking, is held by the Government and is safe from devastation. The rest is being cut and burned with terrible speed. And there is nowhere in the world anything like a sufficient supply of the kinds of timber we use to take the place of what we are destroying.

In the following paper, Major Ahern sets forth the facts and their supporting details with authority. No one in America knows the situations better than he, and no one has ever brought together as comprehensive, as convincing, and as accurate a

statement of the forest situation in the United States as is contained in this Note.

As a young Army officer on the old frontier of the blanket Indian, Ahern personally explored 10,000 square miles of unmapped territory in the Rocky Mountains. His interest in the forest was thus aroused, and beginning in 1888 he mastered forestry—self-taught, for there were no teachers of the subject on this continent.

For some ten years before the outbreak of the Spanish War, where he won a Silver Star and a Citation for gallantry in action, Major Ahern studied the forests of the Northwest. He saw the beginnings of forest devastation there, and earned the undying hatred of the plunderers, whose Senatorial spokesman declared that Ahern—West Pointer, experienced officer, and future Secretary of the Army War College in the World War—"should get nothing out of the Spanish War."

After his military service in the Philippine insurrection, Ahern in 1900 organised the Philippine Forest Service, and was at its head until the outbreak of the World War.

In these 15 years he formulated the forest policy of the Islands, organised the protection and utilisation of 40,000,000 acres of public timber lands, and by his foresight and technical skill laid the basis for a perpetual succession of better and better crops of timber.

What Major Ahern now preaches for America he has practiced with brilliant success in the Philippine Islands.

Whatever may be our theory, in practice we in the United States have steadily treated our forests (except those under public control) not as a farm on which to grow crops but as a mine whose useful product was to be gathered once and for all.

In the Philippines, Ahern not only provided for a perpetual succession of crops under Government control but secured the passage of a law forbidding the alienation of public land for sale or homestead until the Director of Forestry had certified that it was more valuable for agriculture than for forest purposes.

In 1897, at the Agricultural College of Montana, Major Ahern gave practical instruction in forestry. Thirteen years

later he established and conducted the Philippine School of Forestry, and did it so successfully that out of a trained personnel of 500 only 5 to-day are Americans.

Under the supervision of these men timber is sold under restrictions which insure perpetual succession of timber crops, and this system not only perpetuates the forests but has earned cash income enough to pay all the expenses of administration, all the expenses of the Forest School, and $4,000,000 to boot as a surplus for the Island Treasury.

Major Ahern's success in forest conservation in the Philippines was built on Government control of lumbering. That is and has always been the foundation of such success throughout the world. And throughout the world the right of the Government to exercise such control in the public interest is recognised. Without it forest devastation has never been stopped anywhere. Without it forest devastation cannot be stopped in the United States.

The elimination of waste in the use of forest products is valuable. Like a palliative in medicine it may help the stricken patient feel better and live a little longer, but it will not cure his disease. The saving of waste cannot solve our forest problem.

Forest fires are steadily growing worse in America, and fire prevention is absolutely indispensable. But the axe carelessly used is the mother of forest fires. The axe and not fire is our greatest danger. Until the axe is controlled there can be no solution of the fire problem, or of the problem of forest devastation in America.

Over the National Forests, which cover one-fifth of our ultimate possible timber-growing area, and over an insignificant area of other public forests, we have established Government control of the axe. These forests are safe and will produce larger and larger crops of timber as time goes on. Over the other four-fifths of our forest land the axe holds unregulated sway. The National Forests are owned by the Government. On the privately owned lands we must control the axe through taxation (as in Senator Capper's Bill) or by other legal means. If not, the

forests that are left will follow the road of those that are gone already.

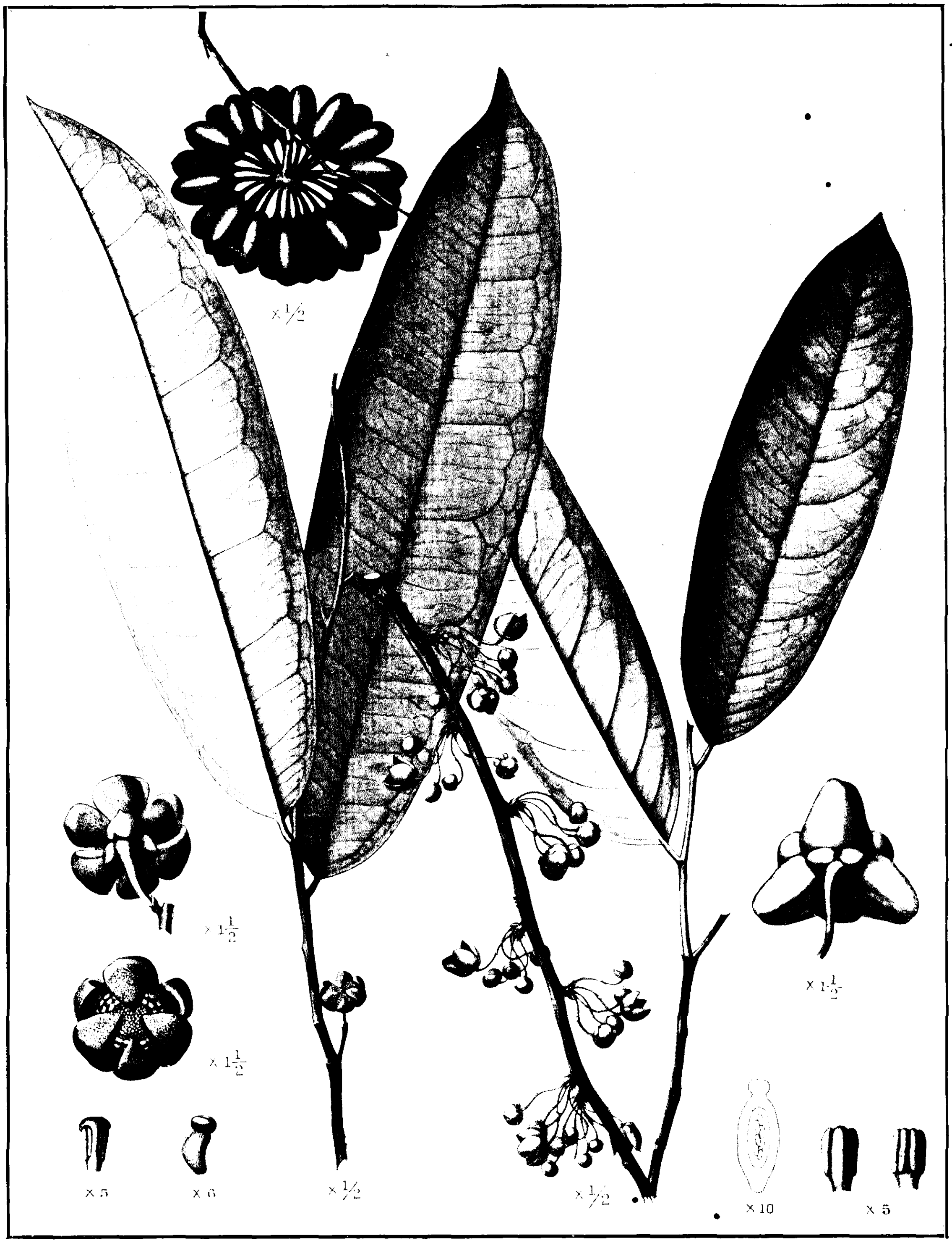
The lumber industry is spending millions of dollars in the effort to forestall or delay the public control of lumbering, which is the only measure capable of putting an end to forest devastation in America. It is trying to fool the American people into believing that the industry is regulating itself and has given up the practice of forest devastation. That is not true, and Major Ahern has proved it beyond question in his most valuable paper.

(Foreword by Gifford Pinchot.)

STUDY OF AUSTRALIAN FAUNA.

The Public Works Committee has recommended the early construction of an Anatomy Institute at Canberra, to cost nearly £100,000, for the purpose of housing Professor Colin Mackenzie's collection of Australian fauna specimens which was presented to the Commonwealth in 1923. The Committee declares that Australian animals are doomed to extinction within 20 years in the absence of urgent protective measures, and for that reason the importance of concentration upon the scientific study of animals while living specimens are still obtainable is obvious.

The Times.



Ganga Singh, del.

Polyalthia crassa, Parker. Sageraea bracteolata, Parker.

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INDIAN FORESTER

JULY 1929.

TWO ANONACEOUS TREES FROM BURMA.

Polyalthia crassa,—Parker, Arbor parva. Folia 12—22 cms. longa 3—7 cms. lata, oblonga, acuminata. Flores solitarii vel pauci glomerati, exaxillares inter vel infra folia, 13 mm. diametro. Petala incrassata, leviter puberula. Ovarium 1-ovulatum, stylus nullus, stigma crassum.

A small tree, twigs glabrous. Leaves 12—22 by 3—7 cms. oblong, acuminate, somewhat shinning above, paler green beneath, glabrous, lateral nerves not very conspicuous, in the larger leaves about 10 pairs inarching well within the margin but additional pairs almost as conspicuous occur between the main nerves, petioles 3—5 mm. long. Flowers 13 mm. diam. green, solitary or few together on small tubercles or very short leafless branches, extra-axillary on the smaller branches amongst or below the leaves, pedicels 5—15 mm. long, puberulous. Sepals 4 mm. long, 6 mm. broad, obtusely pointed, puberulous. Petals very thick, minutely puberulous, the triangular tips remaining curved over the stamens and ovaries outer series slightly smaller than the inner. Stamens very numerous 1·5—2 mm. long, tip of the connective broad suborbicular. Carpels about as many as stamens, a little over 1 mm. long including the globose stigma which is nearly ·5 mm. diam. Ovary hairy ovule 1 basal erect. Fruiting carpels numerous, oblong-ellipsoid, 2 cms. long, glabrous, stipe 12 mm. long (not fully ripe).

Mergui *Parker* 2616, flowering in February.

Andamans *Parkinson* 213, 584, 880, 1010, flowering in January and February.

Sageraea bracteolata, Parker. Affinis *S. Dalzellio*, Bedd. Sed floribus unisexualibus, pedicillis medio bracteatis, stamenibus paucioribus et carpellis numerosioribus. Ab. *S. elliptica* Hook. f. et Thoms. et *S. Listero* King pedicillis multo longioribus inter allia differt.

A small tree glabrous except the inflorescence. Leaves 15—20 by 4·5—8 cms. oblong, narrowed at both ends, thinly coriaceous, midrib depressed above, prominent beneath, main lateral nerves about 10 pairs not conspicuous and not clearly differentiated from the intermediate nerves, petiole 8—12 mm. long, rather stout. Flowers monoecious, both sexes similar in size and shape, red, in clusters on short woody tubercles from the branches below the leaves, pedicels about 2·5 cms. long with small amplexicaul brown-pubescent bracts at the base and a bracteole about the middle. Sepals 3 mm. long, coriaceous, rounded, ciliate. Petals very thick and fleshy, both series slightly imbricate, the outer 10 mm. long, broadly ovate, minutely ciliate, the inner smaller, not ciliate. Stamens 16, the outer larger than the inner and with the connectives slightly produced. Carpels 10, ovules (6-) 7-8, style 0, stigma capitate. Fruit not seen.

Tavoy in evergreen forest *Parker* 2183. Vern. Pa-ngan. The wood is prized for making oars. Flowers November.

Plate 15. Polyalthia crassa. Fruit from Parkinson 584 the rest Parker 2616. Sageraea bracteolata, Parker 2183.

DEHRA DUN.
15th May 1929.

R. N. PARKER, I. F. S.

RESISTABILITY OF INDIAN TIMBERS TO WHITE ANT ATTACK.

An experiment was started at the Forest Research Institute Dehra Dun, in 1926, with the object of testing the comparative resistability of untreated Indian woods to white ant and fungus attack under ground.

Six billets 2″ × 2″ × 2 feet long of each species available were placed vertically in the ground with 12 inches under the earth and 12 inches exposed to the air. The billets are inspected every six months, and the latest inspection report is reproduced below for the information of readers. The results obtained to date are interesting, and indicate, very decisively in many cases, whether a wood is resistant to white ants or not.

Future inspection reports will be published from time to time as they become available.

A—Heartwood not attacked by white ants or fungus, or only slightly attacked by either or both of them.

B—Heartwood of some of the pieces moderately or badly attacked.

C—Number destroyed { W—mainly owing to white ant attack.
F—owing to bad fungus attack.

Serial Number.	Number of specimens.	Species.	Period under test. Years.	Months.	A.	B.	C.	Remarks.
1	1 to 6	Anogeissus acuminata.	3	2	2	3	1 W	
2	7 to 12	Lagerstroemia tomentosa.	2	5	...	..	6 W & F	
3	13 to 18	Bursera serrata ...	3	2	6	.	...	
	19 to 24	Dipterocarpus turbinatus.	3	2	...	...	6 W & F	
5	25 to 30	Dillenia indica ...	2	5	...	...	5 W & F	One missing.
6	31 to 36	Dipterocarpus pilosus.	3	2	...	2	4 W & F	
7	37 to 42	Shorea assamica ...	3	2	1	5	...	
8	43 to 48	Terminalia tomentosa.	3	2	5	...	...	One missing.
9	49 to 54	Bischofia javanica...	3	2	...	1	5 W & F	
10	55 to 60	Castanopsis Hystrix	3	2	.	...	6 W & F	

Serial Number.	Number of specimens.	Species.	Period under test. Years.	Months.	A.	B.	C.	Remarks.
11	61 to 66	Terminalia Chebula	3	2	...	3	3 W & F	
12	67 to 72	Eugenia kanarensis	3	2	3	...	3 W & F	
13	73 to 78	Stephegyne diversifolia.	3	2	...	...	6 W & F	
14	79 to 84	Dipterocarpus tuberculatus.	3	2	...	3	3 W & F	
15	85 to 90	Shorea Talura ...	2	8	2	4	...	
16	91 to 96	Machilus Gamblei...	1	11	...	...	6 W & F	
17	97 to 102	Terminalia Oliveri	2	8	2	2	2 W & F	
18	103 to 108	Stereospermum chelonoides.	1	11	...	..	6 W & F	
19	109 to 114	Planchonia andamanica.	1	11	...	...	6 W & F	
20	115 to 120	Anthocephalus Cadamba.	1	11	...	...	6 W	
21	121 to 126	Albizzia procera ...	2	8	3	1	2 F	
22	127 to 132	Cryptocarya amygdalina.	1	11	...	...	6 W & F	
23	133 to 138	Terminalia paniculata.	2	8	...	6	...	Kiln-seasoned.
24	139 to 144	Terminalia Manii...	2	8	2	4	...	Ditto.
25	145 to 150	Adina cordifolia ...	2	8	...	2	4 W & F	Ditto.
26	151 to 156	Dalbergia Sissoo ...	2	8	5	1	...	Ditto.
27	157 to 162	Lagerstroemia microcarpa.	2	8	5	1	...	Ditto.
28	163 to 168	Lagerstroemia microcarpa.	2	8	5	1	...	Air-seasoned.
29	169 to 174	Terminalia pyrifolia	2	8	...	...	6 W & F	
30	175 to 180	Terminalia Arjuna	2	4	6	...	...	All perfectly sound.
31	181 to 186	Lagerstroemia parviflora.	2	4	4	2		
32	187 to 192	Ougeinia dalbergioides.	2	4	6	...	...	Sap-eaten in one.
33	193 to 198	Dalbergia Sissoo ...	2	4	6	...	...	Sap-eaten up.
34	199 to 204	Dalbergia latifolia...	2	4	6	...	...	Ditto.
35	205 to 210	Terminalia procera	2	4	...	5	1 W	
36	211 to 216	Parashorea stellata	2	4	4	2	...	

Serial Number.	Number of specimens.	Species.	Period under test. Years.	Months.	A.	B.	C.	Remarks.
37	217 to 222	Adina cordifolia ...	2	4	...	2	4 W	
38	223 to 228	Vateria indica ...	2	4	...	...	6 W	
39	229 to 234	Alstonia scholaris ...	2	4	...	...	6 W	In one case rejected due to fungus attack also.
40	235 to 240	Pterocarpus dalbergioides.	2	3	6	...	...	All perfectly sound.
41	241 to 246	Terminalia bialata	2	1	...	4	2 W & F	
42	247 to 252	Albizzia lucida ...	1	11	...	2	4 W & F	
43	253 to 258	Eugenia praecox ...	1	11	...	2	4 W & F	
44	259 to 264	Crypteronia paniculata.	1	11	1	3	2 W & F	
45	265 to 270	Terminalia Chebula	1	2	...	...	6 W & F	
46	271 to 276	Artocarpus Chaplasha.	1	11	6	...	...	All perfectly sound.
47	277 to 282	Altingia excelsa ...	1	11	...	4	2 W & F	
48	283 to 288	Cullenia excelsa ...	1	11	...	...	6 W & F	
49	289 to 294	Grewia tiliaefolia ...	1	11	1	5	...	
50	295 to 300	Hardwickia binata	1	11	6	...	...	
51	301 to 306	Albizzia procera ...	1	11	4	2	...	
52	307 to 312	Eugenia Jambolana	1	11	5	...	1 Dry Rot	
53	313 to 318	Mangifera indica ...	1	11	...	1	5 W. & F.	
54	319 to 324	Dipterocarpus indicus.	1	11	4	2	...	
55	325 to 330	Abies Pindrow ...	1	11	...	4	2 W. & F.	
56	331 to 336	Picea Morinda ...	1	11	...	1	5 W. & F.	
57	337 to 342	Terminalia belerica	1	10	1	3	2 W. & F	
58	343 to 348	Garuga pinnata ...	1	1	...	...	6 W. & F.	
59	349 to 354	Albizzia stipulata ...	1	10	1	5	...	
60	355 to 360	Poeciloneuron indicum.	1	10	1	5	...	

Serial Number.	Number of specimens.	Species.	Period under test. Years.	Months.	A.	B.	C.	Remarks.
61	361 to 366	Bursera serrata ...	1	10	3	2	1 W. & F.	
62	367 to 372	Boswellia serrata ...	1	10	...	1	5 W. & F.	
63	373 to 378	Adina cordifolia ...	1	10	...	4	2 W. & F.	
64	379 to 384	Schleichera trijuga	1	10	4	2	...	
65	385 to 390	Bassia latifolia ...	1	10	4	2	...	
66	391 to 396	Stephegyne parvifolia.	1	10	...	5	1 F.	
67	397 to 402	Cedrela serrata ...	1	9	2	4	...	
68	403 to 408	Cedrela Toona ...	1	9	...	4	2 W. & F.	
69	409 to 414	Calophyllum Wightianum.	1	9	5	1	...	
70	415 to 420	Xylia dolabriformis	1	9	4	2	...	
71	421 to 426	Cedrus Deodara ...	1	9	4	2	...	
72	427 to 432	Mesua ferrea ...	1	9	6	...	...	
73	433 to 438	Cinnamomum cecidodaphne.	1	9	...	5	1 W.	
74	439 to 444	Duabanga sonneratioides.	1	8	1	2	3 W.	
75	445 to 450	Odina Wodier ...	1	1	...	...	6 W. & F.	
76	451 to 456	Albizzia Lebbek ...	1	8	6	...	...	
77	457 to 462	Eugenia gardneri	1	8	6	...	...	
78	463 to 468	Dichopsis elliptica	1	8	5	1	...	
79	469 to 474	Dillenia pentagyna	1	8	...	...	6 W. & F.	
80	475 to 480	Diospyros Melanoxylon.	1	7	...	3	3 W.	
81	481 to 486	Tectona grandis ...	1	7	5	1	...	
82	487 to 492	Diospyros pyrrhocarpa.	1	7	...	1	5 W. & F.	
83	493 to 498	Fraxinus floribunda	1	7	...	1	5 W.	
84	499 to 504	Shorea robusta ...	1	7	6	...	...	
85	505 to 510	Pinus excelsa ..	1	7	2	3	1 W.	
86	511 to 516	Kayea assamica ...	1	6	1	4	1 W.	

Serial Number.	Number of specimens.	Species.	Period under test. Years.	Months.	A.	B.	C.	Remarks.
87	517 to 522	Sterculia campanulata.	...	10	...	...	6 W.	
88	523 to 528	*Chloroxylon Swietenia.*	1	5	2	4	...	
89	529 to 534	Calophyllum tomentosum.	1	5	5	1	...	
90	535 to 540	Pterocarpus Marsupium.	1	4	4	2	...	
91	541 to 546	Artocarpus hirsuta	1	4	6	..	...	
92	547 to 552	Homalium tomentosum.	1	4	6	...	...	
93	553 to 558	Dipterocarpus alatas.	1	4	6	...	...	
94	559 to 564	Heterophragma adenophyllum.	1	3	6	...	...	All perfectly sound.
95	565 to 570	Dipterocarpus obtusifolius.	1	3	...	6	...	
96	571 to 576	Poeciloneuron indicum.	1	3	6	...	...	All perfectly sound.
97	577 to 582	Phoebe Hainesiana	1	2	6	...	...	
98	583 to 588	Acrocarpus fraxinifolius.	1	2	2	4	...	
99	589 to 594	Anogeissus latifolia	1	2	6	...	...	
100	595 to 600	Acer Campbellii ...	1	2	...	...	6 W.	
101	601 to 606	Castanopsis tribuloides.	1	2	6	...	...	
102	607 to 612	Canarium euphyllum	1	2	...	...	6 W.	
103	613 to 618	Cleistanthus collinus	1	2	6	...	...	
104	619 to 624	Dalbergia Oliveri	1	2	6	..	...	
105	625 to 630	Dalbergia paniculata	1	2	6	...	...	
106	631 to 636	Dysoxylum binectariferum.	1	2	6	...	...	
107	637 to 642	Eriolaena Candollei	1	2	6	...	...	Bluish discolouration in one.
108	643 to 648	Gluta tavoyana ...	1	2	6	...	...	
109	649 to 654	Gluta travancorica	1	2	6	...	...	
110	655 to 660	Hopea odorata ...	1	2	5	1	...	
111	661 to 666	Hopea parviflora ...	1	2	6	...	...	
112	667 to 672	Heritiera minor ...	1	2	6	...	...	

Serial Number.	Number of specimens.	Species.	Period under test. Years.	Period under test. Months.	A.	B.	C.	Remarks.
113	673 to 678	Juglans regia ..	1	2	1	3	2 W. & F.	
114	679 to 684	Lagerstroemia hypoleuca.	1	2	6	...	...	
115	685 to 690	Melanorrhoea usitata	1	2	6	...	...	
116	691 to 696	Pentace burmanica	1	2	5	1	...	
117	697 to 702	Parrotia Jacquemontiana.	1	2	..	...	6 W.	
118	703 to 708	Soymida febrifuga	1	2	6	...	...	
119	709 to 714	Bombax insigne ...	1	2	...	1	5 W.	
120	715 to 720	Pinus longifolia ...	1	2	2	3	1 W. & F.	
121	721 to 726	Michelia Cathcartii	1	..	...	6	...	
122	727 to 732	Machilus spp. ...	1	.	...	6	...	
123	733 to 738	Shorea obtusa ...	...	11	6	...	..	
124	739 to 744	Pentacme suavis ...	...	11	6	...	...	
125	745 to 750	Dysoxylum malabaricum.	...	8	6	...	...	
126	751 to 756	Casuarina equisetifolia.	..	8	6	...	...	
127	757 to 762	Dipterocarpus kerrii	...	8	4	2	...	
128	763 to 768	Schima Wallichii ...	...	4	6	...	...	
129	769 to 774	Parishia insignis ...	...	4	2	4	...	
130	775 to 780	Holoptelea integrifolia.	...	4	6	...	...	
131	781 to 786	Hymenodictyon excelsum.	...	4	6	...	...	
132	787 to 792	Polyalthia fragrans	...	4	6	..	...	

Forest Research Institute,

Dehra Dun.

April 1929.

H. TROTTER, I. F. S.,

Forest Economist.

REGENERATION OF EVERGREEN FORESTS IN MALAYA.

By H. R. Blanford, I.F.S., Conservator of Forests, Burma.

(*Continued from pages 333-39, June number*).

Method of treatment now adopted.—As a result of the various operations described above the Malaya Forest Service has arrived at some finality in their regeneration problems. The actual practice still requires a lot of very careful research, not the least of which is how to take advantage of the seed years of the more valuable species, but the general method has proved fairly successful in producing a young crop.

The lines on which the work is now being carried out differ according to whether there is, or is not, a market for the class II material to be cut out in the preliminary fellings. While the two methods are similar they differ in detail and will be separately described.

A.—*Where there is a demand for poles and firewood and preliminary fellings can be carried out by the consumers.*—As the pole fellings which precede other work are rarely carried out according to plan it is better to date the regeneration period from the primary felling of class II trees, calling the year of the latter " n ". The fellings are as follows:—

Year n-1. P. Felling. Removal of unmarked class II poles below 2′ girth by traders.

Year n. S_1 First seeding felling. Class II trees are marked round seed-bearers to form breaks in the canopy. These breaks should not exceed 30 to 40 feet in diameter. Marked trees are extracted by contractors.

Year n+1 (or n+2 or n+3). C_1 First cleaning. A cleaning of undergrowth of *bertam* (palm) etc.

Note:—It is not certain whether this cleaning should be done the year after S_1 or should wait another year or two. After only a year's interval it is difficult to decide what plants really threaten the very small seedlings and it probably also depends on the occurrence of a seed year.

Year n+4. S_2 Second seeding felling. All class II trees over 2′ girth where there is class I reproduction are marked as

well as unsound or misshapen class I trees only fit for firewood. Where class I trees under 5′ girth are deficient, well shaped class II trees (24″ to 26″ girth) may be left. Marked trees are extracted as fuel by traders.

Year n+5. C_2 Second cleaning. All undergrowth especially *bertam* is cut back as well as all class II growth the leaves of which are within 6 feet of the leaves of a class I seedling, sapling, pole or tree. In addition to the above the reproduction is carefully examined and, where necessary, counted in order to verify the fact that good regeneration has been obtained.

Year n+6. F. *Final felling. (Note.*—The actual year of the final felling must depend on the progress of regeneration verified by countings during the course of the second cleaning. Should it be insufficient, the final felling must be postponed until a further cleaning and verification shows that regeneration is satisfactory. At the same time there is great danger of windfall or death of isolated class I seed-bearers and the whole regeneration period should not exceed 10 years).

All marking for felling is carried out by an experienced officer. Generally trees are marked down to the following girth limits :—

Meranti (soft *Shorea* spp.) Class I (*b*) 5 ft. girth.
Penaga (Mesua ferrea L.) 4 ft.
Petaling (Ochnostachys amentacea Mast*)* 3 ft.
All other Class I 6 ft.

Only trees below these girths which will put on the maximum increment from increased light during the next 20 years should be left. A considerable amount of control is exercised over the actual felling so that too many trees are not felled at one time in the same place, as this is likely to do the maximum damage to the young growth.

Extraction is carried out by traders who also convert tops and branch pieces into firewood or charcoal.

Year n+7, or on completion of the final felling.

C_3 *Cleaning and thinning.*—All climbers, etc., are cut back. All badly shaped trees not likely to produce good timber or

firewood are cut out. The more valuable timbers are given preference in thinning and cleaning and other less valuable class I trees whose leaves are within 6 ft. of the leaves of these trees are cut out or girdled. The crop is thinned if necessary.

Note.—Since writing the above I have received the following note from Mr. Rambaut :—

"Our views on marking for fellings are altering. The fellings in which the worst damage can be done by bad marking are the S_1 and S_2.... .... As to F. fellings most of us feel that if there is any doubt about the presence of regeneration, the seed trees should not be felled at all in the Compartment and that if the officer-in-charge of the State is sufficiently confident of the regeneration to recommend F. felling, the marking can be done by anyone).

B. *Where there is no demand for poles or firewood and preliminary fellings have to be carried out departmentally.*

The following is the method laid down in Mr. Sangar Davies' regeneration plan for the forests in the Negri Sembilan State, of which he is the State Forest Officer.

1st year. R. I. F. 1 (Regeneration Improvement Felling).

(*a*) Cutting down or girdling all class II trees whose boles are within the following distances of a class I tree :—

Class I tree	under 10′ in height or 1′ in girth	10′	radius.
" "	between 1′ and 2′ in girth	20′	"
" "	" 2′ and 3′ " "	30′	"
" "	" 3′ and 4′ " "	40′	"
" "	over 4′ in girth	60′	"

(*b*) Cutting down all *bertam* palms, weedy growth and climbers.

4th year. R. I. F. 2. Regirdling or felling all class II trees which have not died, cutting *bertam*, weedy growth and climbers and cleaning class I regeneration.

5th year. F. Final felling. All class I trees are remove by traders down to the same girth limits as have been describe in final fellings under the other method.

Note:—If reproduction is not fairly complete final fellings would have to be postponed for a year or two.

6th year (or year following completion of Final Fellings). C. I. F. Cleaning up regeneration and extension of radius round smaller class I trees by cutting out more class II trees; also probably thinning.

Costs.—In both methods the result is much the same though it must be admitted that the cost in the second case is probably much higher. Actual systematic work under a plan on this method has only just been started. Recent R. I. $F._1$ cost Rs. 8·5 and R.I. F_2 Rs. 7·5 per acre and with the C. I. F. felling the cost will probably amount to Rs. 35 or so per acre. In the first method the cost may also be fairly high but it is offset by the considerable revenue received from class II poles and firewood. The following figures show the average revenue from, and costs of, the various operations on typical areas in the Sungei Buloh reserve, based in most cases on operations in 5 separate cases. The figures have been converted into rupees and decimals of a rupee (One States Dollar = Rs. 1-8-0.)

	Revenue per acre.	Expenditure per acre.
	Rs.	Rs.
P. felling	5·4	...
S_1 felling	34·8	...
C_1 cleaning	...	5·1
S_2* felling	13·8	...
C_2 cleaning	...	6·5
F. felling	(52·3)	...
C_3 cleaning and thinning...	14·6	16·4
Total without F. felling ...	68·6	28·0

Note.—The revenue from the F. felling is much less than would be expected from virgin forest, as the best timber had been extracted from this reserve before work started. (See Dr.

Foxworthy's estimate of Rs. 146 in previous section). The average cost of cleanings in Chikus reserve has been Rs. 6·7 and the total cost in Compt. 3 (a) which we saw, on which C_2 was repeated, has been Rs. 21·8.

Variation. In addition to these two methods, however, there are other variations which are under trial but which, as we were unable to see them in operation, I am only able to describe from hearsay.

In certain forests in Selangor where there is no demand for fuel or poles the State Forest Officer is marking selected class I trees for extraction and the sale is made on condition that the contractor carries out a felling of class II trees and undergrowth free of charge. This is an economical way of getting work done, possibly at the expense of some revenue, and may be necessary where it is difficult to obtain funds to carry out the cleaning operations departmentally. The method has been severely criticised on the score that it entails removal of the seed-bearers on which the future crop is dependant. In a very rich forest however, there should be sufficient seed-bearers left, and we were assured that no class I trees are removed unless ample seed-bearers are left.

Another officer is experimenting with 1 chain wide strips on which a complete felling is carried out leaving intermediate strips 1 chain or possibly 2 chains wide untouched. He claims that these would serve as seed-bearers for the felled strips and that it is more economical to remove the whole crop in one operation even though that operation is confined to alternate strips. Apparently the idea is to leave the unfelled strips for 20 years and then remove them by clear felling relying on the seed from the previously regenerated strips to produce the new crop. If there is any economy in clearing the crop in one operation, which appears to me doubtful, I would, at any rate, suggest the clearing of undergrowth under the strips to be left standing, in which case it may be found that the whole area can be regenerated at once and the overwood removed later. It is quite likely that the side light from the cleared strips together with some removal of low cover will be sufficient to

regenerate the strips on which the overwood is left standing. At any rate, these are the lines on which I would suggest experimenting. I believe that growth on the felled strips would be seriously hampered by the shade from the intervening unfelled strips if these were left for 20 years. At the same time, it seems likely that the strip system may be quite unsuitable because the removal of cover over 1 chain wide strips would open the canopy far too much to allow of reproduction establishing itself. Past experience has shown that gaps opened out should not exceed 30′ to 40′ in diameter. The possible result of the strip system would be a mass of weeds on the strip and a certain amount of reproduction on the intervening unfelled strips.

NOTES ON FORESTS UNDER REGENERATION THAT WERE VISITED.

We visited several forests in which operations similar to those described above were being carried out. In the Sungei Buloh reserve in Selangor State and Chikus and Parit reserves in Perak State work has been carried out by trade removal of poles and firewood as described in A above.

In the Kanching reserve in Selangor State and the Senaling Inas reserve in Negri Sembilan State the work has been done departmentally as described under B.

SUNGEI BULOH RESERVE.

Work was commenced about 1916. We saw compartments in various stages. In some cases the resultant crop was patchy but in others there was a good crop of saplings mostly of various species of *meranti*. It should be noted that in this, as in several other of the forests regenerated by these methods, a good many of the more valuable timbers, in this case notably *merbau* (*Intsia* spp.) but in other cases often the valuable *chengal* (*Balanocarpus Heimii* King) had been cut out by traders before regeneration was started. This has of course resulted in a lack of reproduction of some of the more valuable species. In the most advanced stage which we saw (Compt. 3) work had commenced in 1916 and the final fellings had been completed 2 years before. Over most of the area there is a good crop of *meranti*, hardly what one would

Fig. 1.—Kanching Reserve. Camphor (Dryobalanops aromatica from sowings—about 12 years old.

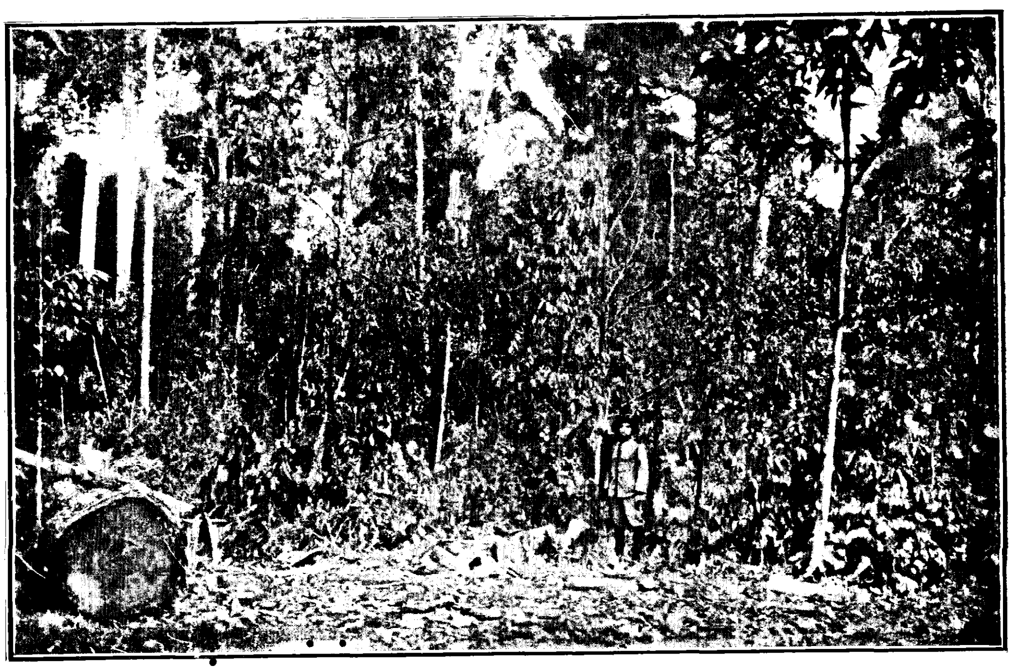

Fig. 2—Chikus Reserve C. 3 (a). Final felling in progress showing survival of meranti and jelutong saplings.

call fully stocked now but sufficient to give a full stocking long before maturity. With its habit of producing long clean boles there does not seem any great advantage in its being grown very close. Two large seed-bearers of *keruing* (*Dipterocarpus* spp.), which had not been extracted in the final felling, had caused good regeneration in an area which was otherwise unstocked and the saplings were pushing their way through the *blukar* (*ponzo* or secondary growth).

Countings of regeneration over areas on which final fellings have been made vary from 200 to nearly 800 per acre. Costs in this area have been heavy owing to the heavy weed growth in this moist low lying forest, but the revenue from all sources is considerable.

CHIKUS RESERVE.

This reserve is bounded on two sides by the railway line and is extremely accessible. Before 1921 the Railway Department worked the forests for sleepers and removed practically all the *chengal* (*Balanocarpus Heimii* King) and *merbau* (*Intsia* spp.).

Regeneration improvement fellings were commenced in 1921 in compartment 3(*a*) (which is in the most advanced stage) and continued until 1924. Cleanings were done in 1924 and 1926. A final felling was in progress at the time of our visit. The young crop varies considerably but in spite of several rather poorly stocked patches is on the whole very good indeed. It is composed mainly of *meranti* of various species with some *chengal*, *keruing* (*Dipterocarpus* spp.) *jelutong* (*Dyera* sp.) and *penaga* (*Mesua ferrea* L.). One of the poorer stocked patches was interesting as it was conspicuous by the fine overwood of *meranti* standing on it. It may be that in this case the overwood had not been sufficiently broken to admit light for the regeneration. Felling was seen in progress and is fairly heavy. It has to be controlled so that felled trees are completely utilized before further fellings are made nearby. Of course, at this stage the damage to the reproduction always looks at its worst but a careful examination shows that sufficient saplings remain undamaged to give a fairly complete crop.

PARIT RESERVE.

The improvement fellings were started in this reserve in 1913-14 when compartment 1 was felled very heavily for fuel. Nearly all class II trees were removed but it appears probable that considerable numbers of class I trees were illegally removed. F. fellings were completed in this compartment, 1(*a*), in 1926 all trees being felled down to 5′ girth. The resulting crop has just been cleaned and is in process of being thinned. Over considerable areas a well stocked crop of *meranti* has resulted but reproduction of other species has notably failed. We also saw compartments 4 and 5, to which a metalled road is now in process of construction which will allow of a full utilization of timber. Improvement fellings were started here in 1918 and were rather heavy; a cleaning was carried out in 1924. The new crop is mainly *meranti* with some *Mesua ferrea* L., *Dryobalanops oblongifolia* Dyer, and *jelutong (Dyera* sp.). The young crop is not very complete and final fellings are consequently delayed. A disturbing feature in this forest is the gradual dying of class I trees which have been left in an isolated position after the S_1 and S_2 fellings. The theory has been advanced that the water level in the soil has been raised as a result of felling and the fact that certain parts of the reserve are undoubtedly waterlogged seems to lend strength to this theory. Personally I doubt if the water level has much to do with the dying of these trees. Trees in this evergreen forest have become accustomed to growth in a dense shade round their boles and in the great humidity of a close crop. I believe that the isolation of stems together with the effect of sun and drier air on the bole is quite sufficient to cause the tree to lose vigour and become stag-headed.

KANCHING RESERVE.

As already mentioned this forest is characterised by a predominance of *kapur* (*Dryobalanops aromatica* Gaertn. f.). Work has been going on since 1910. The earliest operations comprised the cutting out of all class II trees and cleanings in the interest of *kapur* regeneration. Later all class I trees except *kapur* were cut out and finally over part of the area the *kapur* seed-bearers have been removed. (They have been left over parts of the best

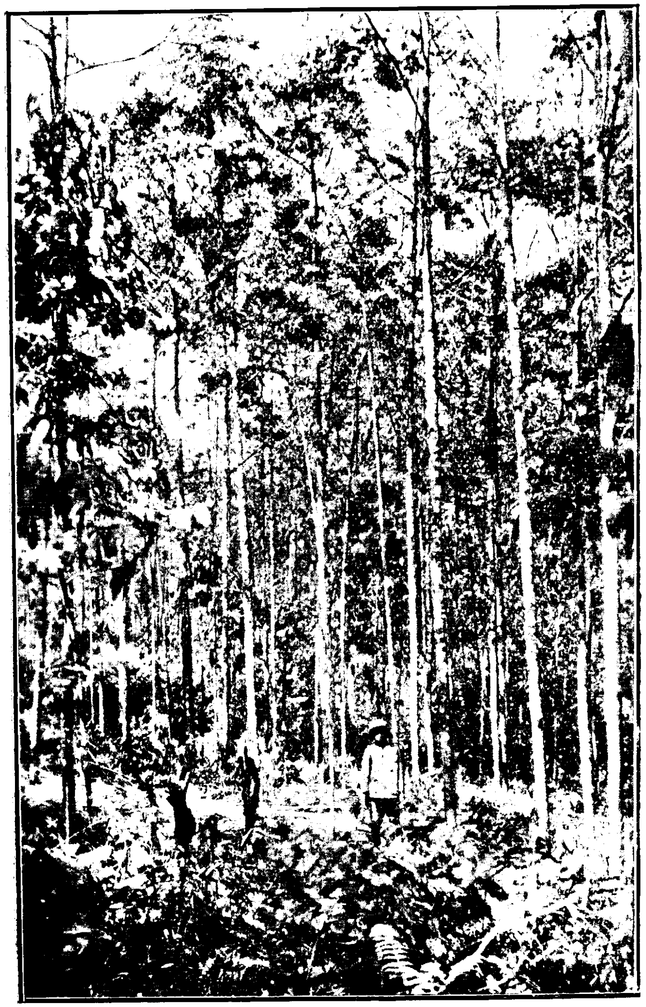

Fig. 3.—Parit Reserve. C. 1 A. Felled very heavily in 1913–14 for fuel but other trees more valuable also taken. Pole forest of meranti just cleaned not yet thinned. Final felling in 1926 all overwood over 5′ taken Windfalls since.

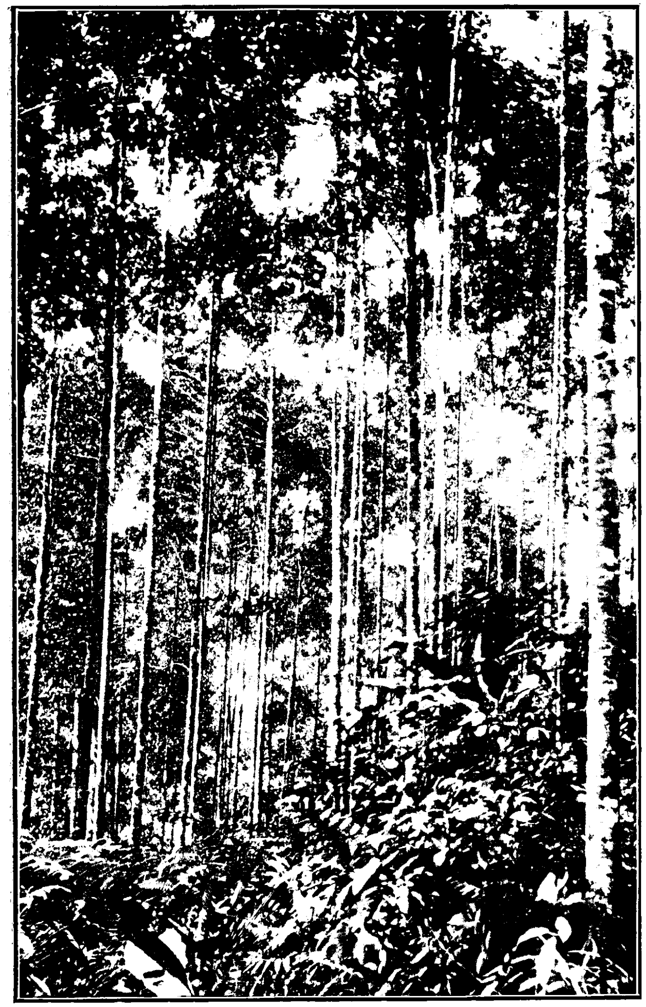

Fig. 4.—Kanching Reserve. Dryobalanops aromatica made as seedling plot in 1916.

Fig. 5.—Senaling Inas. Felled over by N. S. 1 and N. S. 2 and just worked over by R.I F. Shorea Curtisii on left, all class II trees and saplings ringbarked or felled leaving only class I.

Fig. 6.—Senaling Inas. Pole crop of seraya (Shorea Curtisii) after N. S. 1, 2 and 3, only awaiting final felling of overwood.

area to provide seed for artificial regeneration, this being the only forest in which *kapur* occurs on the West Coast drainage). The result is a wonderful pole crop of pure *kapur* which is now thoroughly established over most of the original *kapur* forest. Thinnings have been carried out and sample plots formed There are some views here which would vie with those illustrating the shelterwood system in Kulu in a recent number of the *Indian Forester*. Other parts of the same reserve had no natural *kapur* on them originally and are now being planted, seedlings being raised in bamboo tubes in the nursery and planted out in the tube (which soon rots). Unfortunately the overwood (mainly *meranti*) had already been removed before regeneration, and as a result a dense growth of worthless species had sprung up and planting promised to be a difficult and expensive operation. This shows the necessity for maintaining the overwood until the new crop is established even when artificial regeneration is adopted.

SENALING INAS RESERVE.

This forest, although at a moderate elevation, is characteristic of the type usually found at a somewhat higher elevation.

Characteristic species are:—

Chengal	(*Balanocarpus Heimii* King).
Merbau	(*Intsia* spp.).
Kumus	(*Shorea ciliata* King).
Resak	(*Shorea barbata* Brandis).
Seraya	(*Shorea Curtisii* Dyer).
Meranti	(soft *Shorea* spp.).

Systematic regeneration improvement fellings have just been started under a divisional scheme. Former work was mainly light and experimental and consisted of successive cleanings known as NS_1, and NS_2 (after the state Negri Sembilan). These were light cleanings of undergrowth and useless species, round poles and seed-bearers; generally speaking the canopy was not broken. Results were only moderate, reproduction only appearing where gaps were made, accidentally or intentionally, in

the canopy. About 1924 a third felling, known locally as NS_3, was made over 56 acres. This was much heavier, resembling the first regeneration improvement felling (R. I. $F._1$) now carried out. All class II species were girdled or felled and all undergrowth especially *bertam* (which is a serious pest here) cut over. A fairly complete crop, partly in the pole stage, has resulted from these successive fellings. The species most commonly represented in the young crop are:—

Seraya	(*Shorea Curtisii* Dyer).
Kumus	(*Shorea ciliata* King).
Meranti	(soft *Shorea*).

There is also a certain amount of *chengal* (*Balanocarpus Heimii* King) and *resak* (*Shorea barbata* Brandis).

The overwood, consisting now of class I trees only, will be removed by contractors down to a fixed minimum girth almost immediately. This is the only area in an advanced stage. Other areas had only just had a first heavy regeneration improvement felling carried out and it is still too early for reproduction to show except in patches where it has been induced by the earlier, lighter NS_1 and NS_2 fellings.

DISCUSSION.

Species forming the new crop. So far it must be admitted that *meranti* (soft *Shorea* spp.) predominates in most cases in the new crop. This is the subject of some difference of opinion in the Forest Service in Malaya. Some hold that the objects of regeneration are not fulfilled unless the resulting crop has a good proportion of the more valuable species such as *chengal* (*Balanocarpus Heimii* King), *merbau* (*Intsia* spp.), *resak* (hard *Shorea* spp.), *kumus* (*Shorea ciliata* King and *S. costata* King) etc. Others hold that *merantis* with their faster growth will produce better financial returns. At the same time a good many of the earlier operations were carried out in the forest which had already been skinned of a number of the potential seed-bearers of these more valuable species, and with suitable seed-bearers present in the overwood the young crop should contain a fair proportion of the more valuable kinds. Certainly on the 56

acres in Senaling Inas that had had a third heavy felling carried out over it, and where seed-bearers of the better kinds were still numerous in the overwood, the young crop contained a good mixture of these species. It is true that the different rates of growth of the constituents of the new crop will offer problems which will still make forestry interesting to future generations. Why should we worry about them now? Let it suffice if we hand on a forest that is better than we found it.

Fires. I have omitted to mention fires. In the natural forest in Malaya fires practically do not occur, but they have occurred in felling areas. It is of course essential that fires should be kept out of all regeneration areas in evergreen forests. Practically all the species occurring in evergreen forest are exceedingly fire tender and where there is any danger of fires, protection is a *sine quâ non.* In Malaya the outside chain width of jungle is left uncut, and this is, as a rule, sufficient protection.

Management. There is a point on the management side that is most important. It will have been noticed that class I trees below girths of 5′ or 6′ are left standing at the final felling. The idea is that "the class I trees now between two and five feet in girth will together with a new regeneration of much faster growing class II trees supply a crop for felling after 20 years which will not be poorer than the crop now ripe for felling." (Rambaut [2]). On this rather optimistic theory it is proposed to work over all accessible areas on a 20-year period, trusting to an equal yield of timber and firewood being obtained in the second round. It seems uncertain what will happen the third time round when only the crop now being regenerated remains but, with all due respect to the marvellous growth in the Malayan forests, I can hardly believe that many of the species, with the possible exception of *meranti,* will produce saw timber in 40 years. Apart from that, I believe it is unsound to work over accessible forests in 20 years, even though accessibility is based on conservative limits and larger areas may admittedly become accessible in 20 years time. My reasons are as follows:—

1. In the forests we saw over which the final felling had been made or was in course of being made, (Sungei Buloh Reserve in

Selangor State and Chikus and Parit Reserves in Perak State), there did not appear to be anything like the stock of class I trees left unfelled to compare with the number that had been felled.

2. If class II trees are going to be so plentiful and grow so fast that they will give a yield of firewood in 20 years equal to that already obtained in the regeneration fellings, they would seriously interfere with the class I regeneration and should be cut out long before 20 years have elapsed.

However this is a question of management which can easily be adjusted by lengthening the felling cycle. Indeed many Forest Officers in Malaya agree that the felling cycle of 20 years is perhaps too short. The latest working scheme, which is not yet sanctioned, lays down a 10-year regeneration period and a 30-year felling cycle. It does not affect the actual method of regeneration ; not only is it not advisable to reduce the girth limits in the F. felling from an economic standpoint but silviculturally the protection given by the remaining class I trees may be essential to the well being of the reproduction.

CONCLUSION.

What can India and Burma learn from the Malayan experience ? It is doubtful if we have many evergreen forests as well stocked with valuable timbers as they have in Malaya. Moreover, in Burma, at any rate, few of our evergreen forests are sufficiently accessible to allow of the preliminary fellings being carried out by the trade for poles or fuel. At the same time I believe certain principles do emerge which we should take into account in attempting to regenerate our evergreen forests. They are :—

1. The overwood of valuable timber species should not be felled until fellings in the underwood have induced regeneration.

2. Reproduction of most of the evergreen species, (especially *Dipterocarps*), requires considerable protection and shade during the period of establishment and the canopy must not be opened too rapidly.

3. Seed years are variable and it is desirable to take full advantage of them when they occur.

4. Seed-bearers when isolated by removal of the underwood and secondary species deteriorate rapidly and the final felling should not be too long delayed.

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A TOUR THROUGH KOREA.

BY D. BOURKE-BORROWES.

[This interesting article originally appeared in the Journal of the Central Asian Society, Vol. XV, 1928. Mr. Bourke-Borrowes it will be remembered was at one time Editor of the *Indian Forester.* Ed.]

Excellent Japanese train and steamer services convey the traveller from Japan to Korea, which in the last twenty years has been converted from a self-governing Oriental State into the most important of the Japanese colonies.

Although, for sentimental and other reasons, the passing of the Korean Empire may be regretted, it is well to remember that, before the Japanese domination in Korea, the government was hopelessly effete and corrupt, and the finances of the country in a perpetually bankrupt condition, and that, since that time, the Japanese have given the Korean people the best government they have ever known. Law, order, and security prevail throughout the country, right up to the Manchurian border, and it is evident that the large sums spent in recent years on the development of the country by means of harbours, railways, roads, telegraphs, irrigation works, together with scientific research work of every description, have added greatly to the economic and commercial prosperity of the country and its inhabitants.

There are clear signs, however, that Korean nationalist sentiments, in spite of repression, are still smouldering, and it is

possible that Japanese rule in Korea is the most hated of all foreign dominations in Asia. This seems probably due to the militarist methods of government adopted in the past. It is only fair to add that during recent years the methods of government in Korea appear to have been considerably softened, and the people appear to be more reconciled to Japanese rule than was formerly the case.

Korea is inhabited by one single race, speaking one language, which in itself is rather a curious phenomenon, as Oriental countries usually abound in different races and languages, and even Japan, one of the most homogeneous of nations, possesses within its boundaries a second race, speaking a second language. From their looks, Koreans appear to descend from some ancient Mongolian or Turanian stock, although their exact origin is doubtful. The Korean language has an identity entirely of its own, and cannot be linked up clearly with any other tongue; it possesses an alphabet and, unlike the Chinese languages, is polysyllabic.

Perhaps the most curious feature of all in Korean life is the almost complete absence of any form of national religion. Buddhism exists, but has been so much suppressed and even persecuted in the last 500 years that it only lingers on in certain remote mountain districts. From the Chinese the Koreans borrowed a certain amount of Confucianism and ancestor worship, and also the primeval worship of Heavan—a small replica of the famous temple of Heaven in Peking exists in Seoul, the capital, where the people congregate to worship in times of distress and calamity. In many of the country villages the only visible manifestations of national religion are to be found in the numerous little wooden spirit-houses, and it is possible that these ancient forms of "devil-worship" represent the real spiritual feelings of the mass of uneducated people. It may be added that, for many years past, Christian missions of various denominations have been making a certain amount of progress in Korea.

The old town of Seoul must have been a curious place, whose walls, pierced at convenient points by massive pagoda-like gates, enclosed a perfect labyrinth of dirty narrow streets, only passable for pack-traffic. Since the arrival of the Japanese it has been completely replaced by a heterogeneous Japanese city, whose

ugliness is only relieved by a few large, dignified public and commercial buildings, built in European style out of grey Korean granite; nowadays little remains of the picturesque past except the palaces and a few old temples and gateways. While the modernization of the city was inevitable, and the thoroughness with which it was carried out is a testimony to Japanese organization and enterprise, it is indeed regrettable that so much that was curious and interesting was ruthlessly swept away in the process.

The Korean climate is one of extremes, but in spite of this the Koreans dress all the year round in white cotton cloth, well padded in winter with cotton-wool, and white is the national colour of mourning. During the Korean Empire the streets of the capital were bright with coloured robes; and women, when moving abroad, closely veiled themselves by drawing over their heads peculiar bright green robes with little crimson sleeves; these robes were never worn on the body, but only used as a covering for the head. Nowadays, the veiling of women has fallen into disuse, and since the death of their Emperor and the disappearance of their royal family, the entire nation seems to have gone into permanent mourning. Much has been written about the peculiarity of the men's hats, the most inexplicable form being the little black top-hat made of woven horse-hair perched on the top of a large skull-cap, which fits tightly on the owner's head; other curious types are supplied by hats shaped like inverted flower-pots and hats resembling small bishops' mitres.

Central Korea stands out as a fine rolling agricultural country intersected by mountain ranges, many of which are celebrated for their beautiful scenery. When the Japanese took over the country seventeen years ago, they found the hills bare of all woody vegetation—the Koreans, like the Chinese, having a perfect passion for destroying tree-growth—and it is to their eternal credit that they should have succeeded in so short a space of time in reclothing the denuded slopes with millions of young trees, chiefly pines and other conifers.

As the traveller passes northwards, the scenery changes into a land of steep, rugged mountains, and streams winding through narrow stony valleys, with little farm-houses built of clay and

stone, roofed with thatch and rough shingles, nestling in the valleys or on the lower hill-slopes. The general landscape is startlingly like many upland tracts in Asia Minor and Kurdistan and this resemblance is much enhanced by the appearance of the local population; both sexes wear, as part of their costume, short white jackets and voluminous baggy trousers; and the men especially, with their stocky figures, Mongolian features, and thin black beards, look just as if they had stepped out of some Turkoman or Central Asian tribe of nomads.

With the great recent increase of population in Northern Korea—largely due to the stability of Japanese rule—pressure on the agricultural land has very much increased, but fortunately there is a great outlet for the poorer classes in the mining industry. The rocks in the mountains are highly mineralized, and the whole region contains many kinds of minerals and is specially well-known as a gold-bearing area. Every peasant-farmer is a potential miner, and whilst ploughing his fields will stop at frequent intervals to examine the rocks which his plough has turned up. During the slack seasons the farmer digs for gold on his own account, crushing the ore in batteries of wooden stamps worked by water-power, or goes to work at one of the European or Japanese mines established in his neighbourhood. Although the Korean is counted as lazy and improvident when compared with his more industrious neighbours, yet no one has ever been heard to say a word against Korean mining labour, which is universally praised as the best and most reliable in Asia.

After spending some time on a gold mine in the northern mountains, watching the complicated process of gold mining with modern machinery, I set out northwards towards the Yalu River with a small string of shaggy Korean pack-ponies, and a sturdy pony-man in charge. The trail led over rocky passes and along narrow valleys fringed with groves of poplar and wild pear trees, whose branches were full of chattering magpies. As we passed on the way clusters of farm-houses, I noticed the pigs grazing outside, each one tethered to a wooden post, with a bent birchwood collar round its neck. Above us, on the mountain sides, the sturdy farmers were ploughing on slopes which, in most countries, would

be considered impossible for regular agriculture; higher still, on slopes too steep for the plough, men and women, crouching and clinging on to rocks, were hoeing and weeding the scanty hill-crops.

A profusion of beautiful spring flowers covered hill and dale like a jewelled carpet—lilies, pinks, acquilegias, campanulas, asters and many other familiar flowers, and among the flowering shrubs white may, hawthorn, hydrangeas, syringas, white lilac, and masses of wild roses were very noticeable. The air was so mild that, although carrying with me no tent, I was able to avoid the vermin infested farm-houses and to spread my camp-bed at the end of each day under the shelter of some wild pear tree, near some flowing brook.

After three days' marching I reached the Yalu River, and an afternoon and an evening spent in a Korean junk, floating down stream through gloomy rugged gorges and past long stretches of flourishing cultivation, brought me on the following morning to the Japanese railway town of Singeshu. The traffic on the river is remarkable for the large numbers of timber rafts which are constantly being brought down from the forest country at the head-waters of the river to the sawmills at Singeshu, and at Antung on the Manchurian side of the river.

Once across the river, the journey is continued to Mukden along the Southern Manchurian Railway, across the fertile plains of Manchuria, covered with splendid crops of millet, maize, wheat, and soya beans—the products of this last-named crop furnish the greater part of the wealth and industry of Manchuria.

NOTE ON VEGETATOIN ON FOREST SOILS.

By A. H. M. Barrington, Rangoon, 1929.

Mr. Barrington is evidently one of those who are interested in the recent developments of forest ecology in its practical application, and has taken advantage of the opportunity offered him

as Conservator of the Hlaing Circle in Burma to carry out a detailed study of the soil and vegetation of a number of plots of forest selected as representative of the chief types occurring in the area. The publication before us affords an interesting example of the value of co-operation between the forester, the soil expert, and the botanist, and whilst we must agree with the author that the results do not take us very far at present, we are indebted to him for a thorough preliminary survey of a complex problem, the solution of which may some day be of the greatest practical importance to forestry. In particular, it is a matter for congratulation, that the author has published all the essential field data from which he attempts to draw conclusions, and that he has permanently demarcated his plots so that he or anyone else can return to them at any later date to check any doubtful figure, to collect additional information, or to record any changes which may have occurred : far too usually such studies are deprived of much the greater part of their value by neglect of these points.

To refer briefly to the data collected, 25 plots have been studied scattered over the 5 divisions of the circle. The vegetation has been recorded as far as this was possible in the cold weather months, and chemical and physical analyses have been made of soil samples from 4 to 7 depths, each sample being the average of 4 or 5 borings. Four types of soil and vegetation are differentiated and a chapter is devoted to each of them, describing first the soil and then the vegetation. There is also a special chapter summarising the information collected towards a classification of the forest types and the plant indicators which appear to characterise each type of soil, but we are warned not to take the soil classification "very seriously." As it stands, quite respectable numbers of indicators are listed as seeming to occur on only one of the 4 soil types and to be very usually present on that type.

The attempt to refer the quality of teak to be expected from each type of soil to the physical and chemical properties of the soil is also mentioned rather incidentally in the letter press, but is summarised in diagrammatic form. We can only say that the diagram appears more like a representation of a series of

superimposed lightning flashes than anything else, and it would defy the most industrious to decipher any useful generalisation of the kind required, though the tendency towards the development of soil layer of maximum stiffness at a depth varying with the plot is well brought out.

There are many other points of interest which cannot be referred to in this review: those interested in the subject will be well advised to read the note carefully, particularly if they are doing similar work themselves or are contemplating doing so: foresters in general ought to know what it is about, and those in the Hlaing and adjoining circles could make a useful contribution to science by studying it in the light of their own experience, and by extending Mr. Barrington's series of plots.

H. G. C.

EXTRACTS.

AUSTRALIAN SLEEPER SUPPLY.

The following is an extract from a paper read before the Engineering Conference, Canberra, by C. E. Lane Poole, Inspector General of Forests, Australian Forestry School:—

"The specifications of sleepers are, on the whole, very high, far higher than those in the lines of the continent of Europe, or the United States of America. Except for Queensland, square sleepers alone, are accepted. The Northern State employs "hog-backed" sleepers, which appear to give excellent results. The Queensland evidence tends to show that there is no engineering reason against the use of "hog-backed" sleeper, while the saving in timber is considerable. There are large areas of second class forest, which, while not yielding the die square hewn sleeper, will give numbers of 7-foot logs showing enough heart to make what the Queenslander calls "twoers." These can be sawn down each side and down the middle, to make two 9" x 5" sleepers, with rounded sides." . .

"If the development of Australia by means of railways, is to continue, then the future supplies of sleepers is a matter that must be very seriously considered. What remedies have we? How can we eke out present supplies till the new crop is grown? The remedies are not many, and some of them will be scouted by railway authorities as being too expensive or impracticable. I, however, urge their consideration for very soon, if something is not done, the cost of raw material, will rise to a figure far greater than that of the remedies proposed :

1. Modification of the specifications to that in use in the Queensland Railways ;
2. Impregnation of timber so as to lengthen the life of the durable timbers and render non-durable timbers durable ;
3. Seasoning ; and
4. Better methods of fastening rails to sleepers."

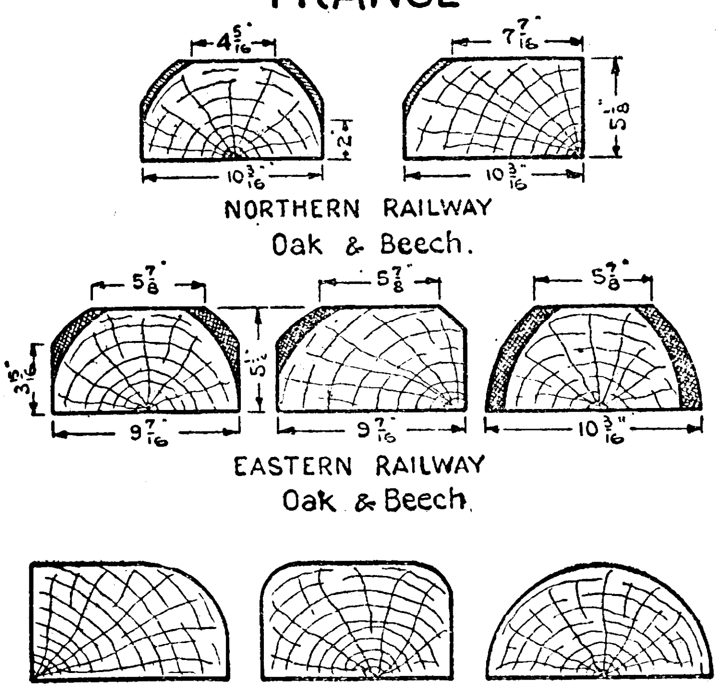
"Lengthening the life of the sleepers now being renewed, is the most satisfactory method of eking out supplies. If, by impregnation, by seasoning, and by better methods of fastening, we can get 10 more years life out of our sleepers, we shall clearly be reducing our annual renewals by over a half, and so saving both timber and cost. The importance of seasoning sleepers, before putting them in the line, is not generally recognised. Seasoning, undoubtedly, lengthens the life of the sleeper by increasing the holding power on the dog spikes and reducing the risk of attack of fungus disease. Adzing and boring, before seasoning, is the best practice, as this hastens the seasoning at the rail seat."

"If, in addition to remedies aimed at lengthening the life of the sleepers, we reduce our standards, and accept a specification which permits the use of inferior sized trees for sleepers, we shall not only be able to go over our forests again, but also open up areas which up to now, have been regarded as valueless for this purpose. In this way, the existing supplies, that Nature has given us, will last longer and foresters will be given a little more time to renew the cut over areas."

[The paper is illustrated by the accompanying sketches].

TYPICAL SECTIONS OF CONTINENTAL RAILWAY SLEEPERS.

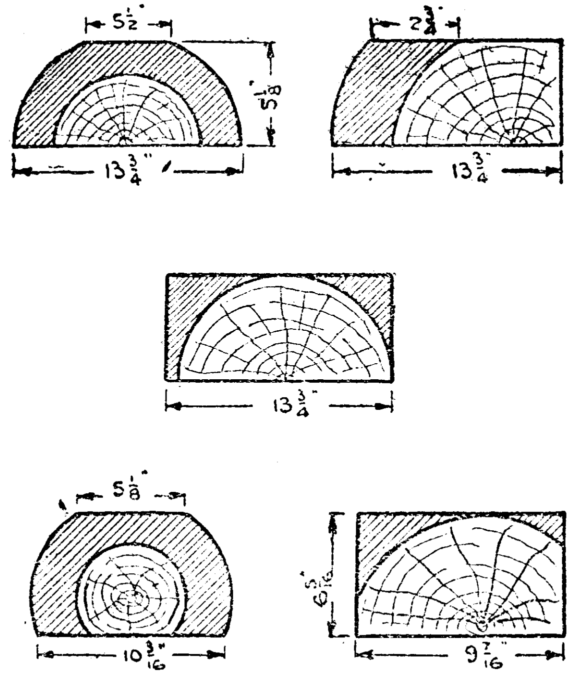
FRANCE



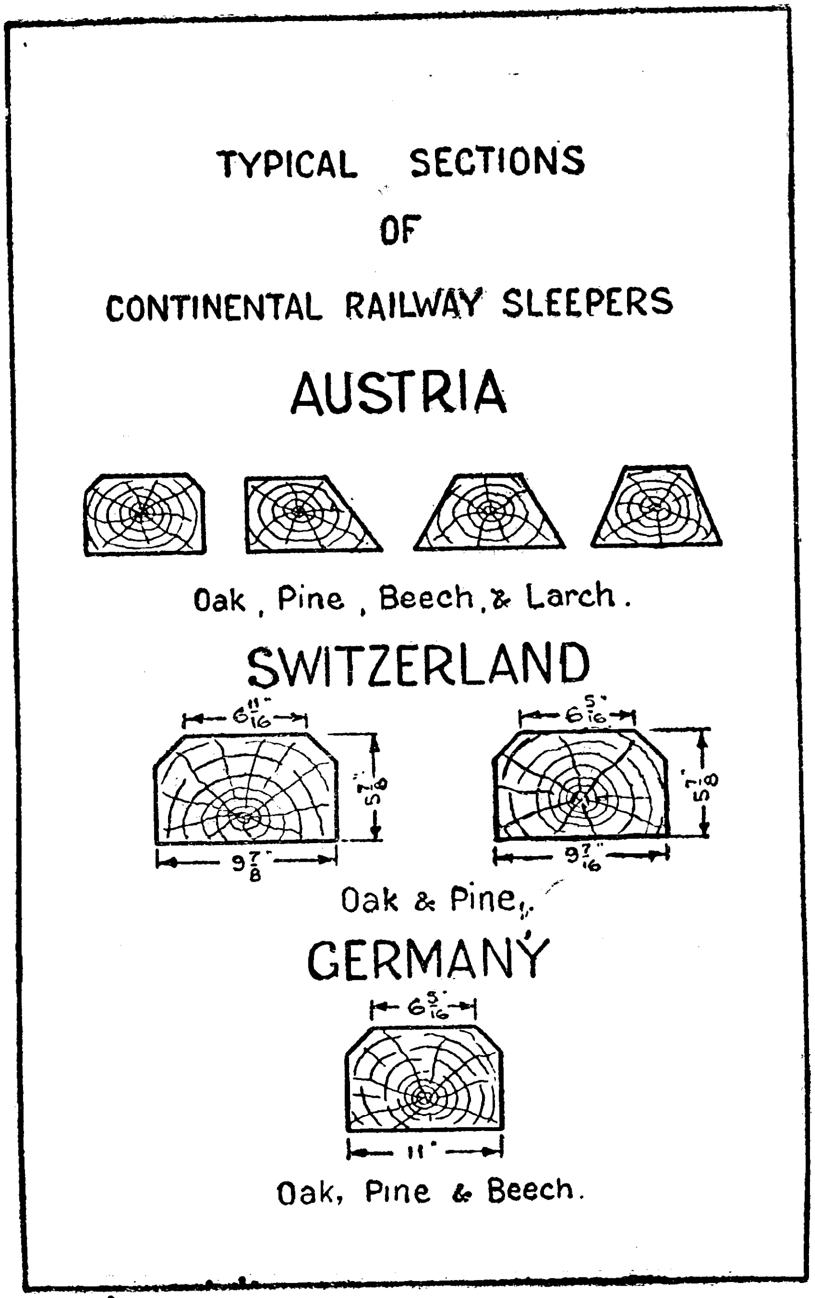
STATE RAILWAY.
Oak & Pine.

TYPICAL SECTIONS OF CONTINENTAL RAILWAY SLEEPERS.

FRANCE

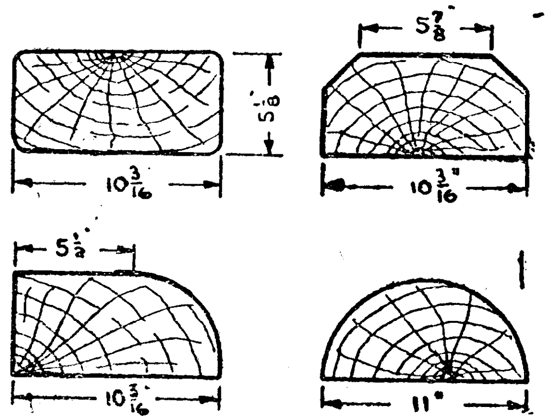


MIDLAND RAILWAY
Cluster Pine.


TYPICAL SECTIONS
OF
CONTINENTAL RAILWAY SLEEPERS
AUSTRIA
Oak, Pine, Beech, & Larch.
SWITZERLAND
6 11/16"
5 7/8"
9 7/8"
6 5/16"
5 7/8"
9 7/16"
Oak & Pine.
GERMANY
6 5/16"
11"
Oak, Pine & Beech.

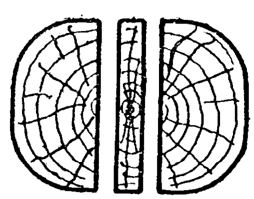
TYPICAL SECTIONS OF CONTINENTAL RAILWAY SLEEPERS.

SPAIN



Oak, Pine, Beech & Fir.

METHOD OF SAWING SLEEPERS.



SUBSTITUTES FOR TIMBER.

A Forestry Officer's Suggestion.

A suggestion that substitutes for timber should be used to a greater extent in view of the scarcity of soft woods throughout the world was made by Mr. O. J. Sanger, Divisional Officer of the Forestry Commission stationed at Shrewsbury, in an address which he delivered at Liverpool.

We were faced, he said, with a worldwide shortage of soft woods, which would make itself felt in a comparatively short time. Thanks to our command of the sea, we could draw on the timber resources of the world, but such purchases cost us more than £60,000,000 a year. The existing soft wood forests were growing at a rate very much below their maximum, and were producing annually less than half of what they should be yielding.

There was no reason to anticipate an appreciable reduction in world demand until it was enforced by restriction of supply and mounting prices, as was already evident to a small extent in America. Moreover, there was no indication that the hard woods would come to the rescue. The position generally was so serious that the timber trade must encourage a wider use of substitutes, such as the products of pulpwood, which could be grown in a relatively short time, and the elimination of waste.

Economic Committee's View.

The subject with which Mr. Sanger dealt was reviewed at length in the report of the Imperial Economic Committee on Timber, which was issued last year. The Committee pointed out that the distinction between what are known as "soft woods" and "hard woods" is not a rigid one either commercially or botanically, but it is sufficiently definite to be of direct practical importance. Soft woods are chiefly used in ordinary building construction, for pit props, for general utility purposes, and in the manufacture of wood pulp. Hard woods are mainly used in portions of building subjected to hard usage, such as flooring, while in many cases, on account of their beauty, they are valued in the furniture trades and for decorative work, such as panelling.

Forestry authorities all over the world, the Committee stated, regarded the world supplies of soft wood with anxiety, but this feeling was not shared generally by the members of the timber trade in Great Britain. Adequate supplies had always been readily available in the past, and it was possible that the trade had been lulled into a feeling of security for the future which the world position might not warrant. The outlook was more fully realized by those concerned with organized forest management and conservation, and the Committee urged the need of systematic investigation of the rate at which the forest resources of the world are being depleted.

The scarcity of soft wood might be met to some extent, the Committee suggested, by greater use of the lighter kinds of hard wood which are grown in the British Empire. Investigations in India showed that certain of these lighter hard woods could be seasoned so as to be similar in colour and working properties to the recognized soft woods. Some of the little-known woods of Nigeria, it was also believed, possessed similar properties. If these lighter kinds of hard woods were used in place of soft woods and supplied at competitive rates a large market could be opened in Great Britain for many species of Empire woods at present unmarketed.—*(The Times.)*

FORESTRY IN THE GRAMPIANS.

12,000 Acres Acquired by the Commission.

The Forestry Commission have acquired some 12,000 acres of land in the Grampian range of mountains, and, in view of the policy of the Commission, it is hoped that parts of the area which are regarded as unsuitable for afforestation may be made available for national recreation. Of the 12,000 acres acquired, rather more than 4,000 are suitable for afforestation.

The first duty of the Commission is to plant the areas which they acquire, but acquisition sometimes include considerable portions which are of little value for planting but are typical of some of the finest hill scenery. Such areas may be very attractive to the mountaineer and suitable for recreation purposes, and the

Commission are prepared, subject to the necessary safeguards, to transfer areas of this character for national recreation. It may be recalled that in 1927 the Commission transferred to the National Trust a considerable area at Ennerdale, in Cumberland, for the use of public. In transferring any such areas the Commission are careful to make terms that will safeguard the forests and also ensure that the State shall suffer no loss. Grazing and sporting rights would be reserved.

The Commission are prepared to negotiate for suitable areas for commercial afforestation anywhere. With regard to land in the Grampians, the more the Commission can get there, the more they are likely to find areas that would prove suitable for recreation purposes. Over 1,200 acres have been planted in this Highland area. Two crops of good Scots pine have been cut in Glenmore. The Commission are guarding what remains of the old stock for regeneration purposes ; and they are planting all round Loch Morlich, a district noted for Scots pine.—*(The Times.)*

THE RIDDLE OF DIHANG ; ASSAM FRONTIER EXPEDITION.

In 1927-28 a botanical and horticultural expedition, financed by the Percy Sladen Memorial Fund, by the Government Grant Committee of the Royal Society, and by a private syndicate of amateur gardeners arranged by Mr. Lionel de Rothschild, was projected to the Assam frontier. The main objective was the Mishmi Hills, in the unadministered tract ; but before the expedition started up the Lohit river it was able to make a short trip among the Abor tribes of the Dihang valley.

(BY CAPTAIN F. KINGDON-WARD.)

Seventeen years ago all India was startled by the news of the murder of two British officers, while on a journey of exploration on the Assam frontier, by the savage Abors of the Dihang valley. At that time it was still widely believed that the Tibetan Tsangpo, which on the plateau near Lhasa flows at an altitude of 11,000 ft., before emerging again into known territory as the Dihang of Assam, less than 1,000 ft. above sea level, fell over a

huge cliff somewhere in the bowels of the *Himalaya*. It was partly with the object of discovering these mysterious "falls of the Brahmaputra" that the two unfortunate officers set out on the journey from which they never returned. This, however, was but the climax to a series of regrettable incidents. There had been previous minor expeditions against the Abors, whose presence on the frontier was a perpetual menace to the peace of the plains; but, being conducted in a half-hearted way, the results had been negative. No wonder the ignorant Abors, secure in their big fighting villages, had defied the white man's village of Sadiya, which to them was India"!

The Abor punitive expedition of 1912 rather ponderously avenged the murder, and a second expedition in the following year mapped the unknown course of the river to the very foot of the snow range through which it bursts its way; and no falls were found. When the columns were withdrawn, a permanent post was established at Pasighat, where the Dihang comes bowling out of the hills which rise abruptly on either side, pressing the river into a narrow but terrifically deep bed; and a grip was kept on the valley as far as the murderous village of Kebang, 40 miles up stream.

RENEWED INTEREST.

When the European War broke out, all activity on the north-east frontier ceased; but, now that things have settled down again, there are signs of renewed interest in this back-door to India. Apart from questions of policy, men's thoughts are again turned to those confused mountains through which a hundred shouting rivers have drilled their gutters from the roof of the world to the plains.

But the Dihang valley is shut. No white man is allowed to travel there, because the Abors are treacherous. Periodically the Political Officer from Sadiya visits the lonely graves of the murdered officers, to see that they are being properly respected; otherwise the Abors, within a few miles of Pasighat, are left to themselves. Preparations being afoot for one of these expeditions beyond what is known as the "inner line," the Political Officer kindly invited me to accompany the column, and I gladly accepted an invitation to visit a part of the Indian frontier which few white men have seen, and to botanize in an almost virgin field.

The column, which consisted of the Political Officer, Sadiya Frontier Tract, the Assistant Political Officer, Abor Hills, with headquarters at Pasighat, the officer in command of the escort (two platoons of the Assam Rifles) and myself, with 90 coolies drawn from the Nepalese Cooly Corps and the friendly Minyong Abor clan, assembled at Pasighat.

From the narrow shelf where the post crouches between the river and the hills we plunged headlong into the evergreen jungle, and immediately began to climb. The weather was fine, and from the spurs which buttress the lofty hills we had wonderful views up and down the corrugated valley. At one point we stood on a bluff overlooking the river, and could see fish loafing in the cold green depths 200 ft. below us. On the third day we reached Kebang. The last block-house stands in a clearing on the cliff, at the end of the mule path. Just above this point the Dihang widens out and can be crossed by raft, the path continuing up the left bank. From Pasighat for a day's march we had been in administered territory, whence, as far as Kebang, the valley is under loose political control. Yet immediately across the river is independent territory, where savage tribal warfare was being waged within sight and sound at the time of our visit. But no Englishman is allowed to cross the "inner line" beyond Kebang without an escort.

"ENEMY" TERRITORY.

It took most of a day to raft the troops, coolies, and supplies across the river, where a perimeter camp was built. On the river bank is the grave of Dr. Gregorson, who, according to the inscription, was murdered "near this spot" on March 30, 1911. From here onwards we were in "enemy" territory. The path was so narrow that we had to march in single file, the sepoys with fixed bayonets guarding the long line of transport coolies. Communication between the advance and rear guards was by whistle, but so thick was the jungle that it was impossible to throw out flank guards, except when the column halted. At the foot of the hill on which stands the village of Komsing, screened by clumps of bamboo, screw pines, and jack fruit, a perimeter camp was established, and here we prepared to spend several days.

On arrival we were met by the Gams, their lean figures wrapped in scarlet blankets, with cane helmets on their heads and spears in their hands; later we walked up the hill to the village of Komsing.

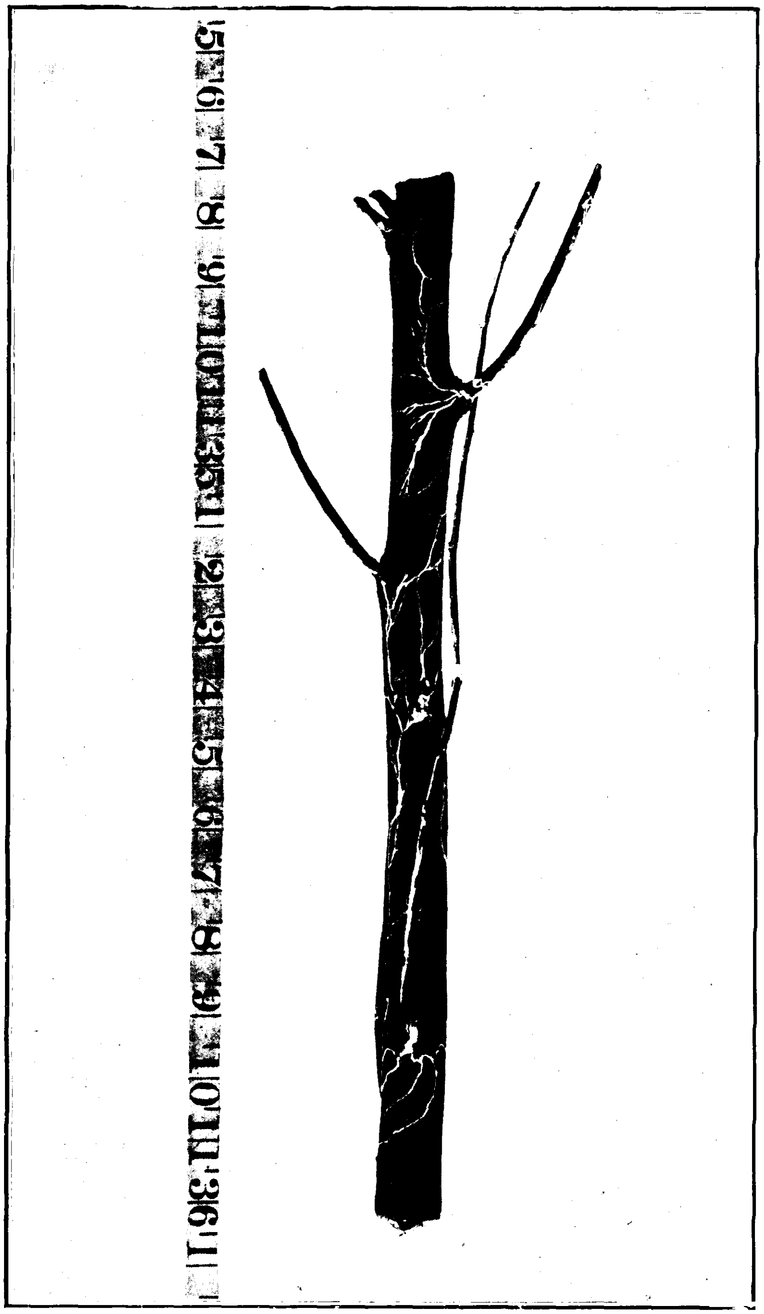
Beyond the highest huts there was an open space, and here, in the shade of a solitary tree, the Political Officer held a council with the Gams. It was a striking scene, on the edge of the Empire, the Political Officer seated in the midst of those white-headed old warriors talking to them easily and persuasively in their own tongue, joking with them, but under the veil of friendship and laughter never failing to impress on them that the displeasure of the *sircar* was not to be lightly incurred; and around the group the sepoy guard stood leaning carelessly on their rifles, alert for the least hint of trouble. Outside the circle of elders, in the hard light, stood the young bucks of the village, fierce-looking men armed with long knives in wooden sheaths, or with bows; and all about wandered mithan and pigs and fowls. Close by was a large heap of stones surrounded by a bamboo fence; and on one stone, built into the mound, the following inscription was cut: "Near this spot was murdered Noel C. Williamson, March 30, 1911."

It was a drowsy afternoon and the village, wrapped in sunshine, looked very peaceful. So, too, it may have looked on that fatal March afternoon 17 years before, when Noel Williamson, eager to unravel the mystery of the falls, was treacherously cut down from behined by Kebang Abors, perhaps at this very spot. The tragedy was made moie poignant by the fact that the two officers were murdered on different days, Dr. Gregorson having stayed behind at the ferry with fever. Williamson had been told that from a high spur just ahead he would be able to look down on to the Dihang and with his eye follow its course through the Abor Hills. But with the solution of this age-old problem apparently in sight came the end. His murder paved the way for the unravelling of the riddle, and how far Williamson really was from his goal, at Komsing, only became clear later. It is easy to be wise after the event; even so, no big river that the writer has ever seen looked less like pouring over a cliff than does the

Dihang in the Abor Hills. Approaching the great gorge from the Tibetan plateau, however, where the mile-wide Tsangpo gathers itself up to batter a way through the ring of snow mountains which threatens to envelop it, a different impression is gained. From the profound depths of the gorge one might always believe that round the next cliff the raging river finally disappeared into a bottomless pit.

A SAGACIOUS PEOPLE.

One thinks of the Abors, filtered out from the migrating swarms of Asia by the tangled web of mountain and forest which lies between the cold plateaux of Central Asia and the fertile plains of India, as uncouth savages. Their record is bad; yet they are far from being savages. Even apart from their elaborate religious ceremonies, the outward and visible sign of their sagacity and civilization is to be found in their well-built huts, sometimes 600 or 800 to a village, in their warm, gaily coloured clothing, and well-wrought ornaments, their weapons, domestic animals, and agriculture. But in nothing is their skill so manifest as in the construction of bridges. Whereas most of the jungle tribes are content with a single bamboo rope stretched across a lesser river, precariously suspended from which the traveller, taking his life in his hands, must painfully haul himself from one bank to another, or at best with a cane hammock bridge, the Abor constructs over the mighty Dihang a tubular cane suspension bridge, wrought with the cunning of the spider. There is such a bridge below the ferry at Kebang, where the river narrows to about 200 yards; but the total length of the bridge, allowing for sag and for the overlap up each cliff, is about 800 ft. The bridge is in the form of a narrow hammock, but the central portion is converted into a tube by means of cane rings placed at intervals; and the sense of security thus given is needed, for the wind, driving through the gorge, blows the bridge on to its side, and the whole structure sways and wriggles under, foot like a live thing. Suspended 100 ft. above the river in the middle, thousands of feet of rattan being used in its construction, this monstrous piece of engineering marks the utmost skill in jungle craft.—*(The Times.)*



Sal Thicket Fungus.

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PRELIMINARY NOTE ON THE INVESTIGATION OF SAL THICKET FUNGUS DISEASE.

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I. *Introduction.*—Of the various fungus parasites of sal (*Shorea robusta*, Gaertn.), the one that has recently been taken up for investigation is a thread blight commonly known as Sal Thicket Fungus. From information available on this subject, as far as can be gathered from official correspondence, this disease appears to have come to the notice of this department in September 1910, when certain specimens of sal fungus were sent to Dehra Dun from Angul Division, Orissa, for identification. A specimen of this fungus was received nearly six years later, in December 1916, from the same Division, and a report was accordingly sent. Interest in this subject was awakened when a fresh supply of specimen of Sal Thicket Fungus was sent by the Divisional Forest Officer of Angul in December 1928 and in the following February a tour was taken to the Angul forests to study the field conditions of the disease.

II. *Symptoms of the disease.*—The apparent symptom which strikes one is the white mycelial strand or cord which sticks to the surface of the bark and runs upwards (Plate 19) to the leaves. The attack of the fungus is first confined to one side of the stem. As the mycelial strand passes upwards, it runs to the smaller branches or twigs, consequently its course along the stem

is never straight but zigzag. At the axils of smaller twigs, the thread develops into a small oblong cushion of white mycelium or raised up dots composed of fungus tissue. The small cushion breaks up into thinner strands which run upwards to the axils of the leaves. The course of the main and the thinner strand is very clearly defined and can be seen at a distance of 10 yards or so from the infected saplings. During their upward passage the strands form still smaller cushions at the axil of the leaves where generally a small patch of bark is killed. The young buds in the axils of the leaves and also the terminal buds are sometimes wholly covered by mycelial felt. From the petiole the strands reach the leafblades, where they split up again in a similar fashion into numerous extremely fine delicate threads which spread in a characteristic fan-shaped manner in all direction over the leaf. But on the midrib and side veins the mycelia threads may reunite to form white strands as on the stem, though very much finer than those. The attack of the fungus is more marked on old than on young leaves. In the early stage the attacked part of the leaf shows by a greyish white appearance the first symptom of decomposition of cholorophyll, but later on, the infected portion turns yellowish brown. Thin mycelial threads are easily visible on this area by a 15x pocket lens. Occasionally a still later stage of infection may be seen on the same leaf and dull yellowish brown patches here and there may signify tissues that are completely dead. After the fall of the leaves, the attack is renewed when the flush of new leaves comes out. The strand of mycelium attached to the stem grows out again as soon as the dry period of summer is over and rain starts. The fungus not only causes an early defoliation but also kills the young terminal buds. Die back of the branches and leading shoots follow, resulting often in a stag-headed condition of large saplings, while in the case of smaller saplings the fungus ultimately succeeds in killing them. The fungus does not spread to the underground parts of the plant consequently the collar and the root system of the infected plants are completely healthy.

III. *Notes on the field study of the disease.*—During the tour three ranges of Angul Division *viz.*, Puranacote, Bagmunda and

Raigoda, where this disease is rampant, were inspected. This fungus, a dangerous parasite of sal growing in unfavourable localities, has not confined its attack to one species. The following species which are commonly associated with sal regeneration in that area have been found attacked by it. It is difficult to say if the fungus behaves as a parasite on all the species to the same degree, but some of them have been noticed to fall victim to its attack. The list, though by no means complete, gives an idea how the infection spreads from one plant to another by the medium of various climbers and other forest shrubs.

1. *Combretum decandrum*, Roxb., (healthy).
2. *Ventilago calyculata*, Tulasne, (healthy).
3. *Buchanania latifolia*, Roxb., (killed).
4. *Terminalia tomentosa*, W. & A., (moribund).
5. *Terminalia belerica*, Roxb., (killed).
6. *Zizyphus Jujuba*, Lam., (moribund), Pl. 20, Fig (1).
7. *Urena* sp., (killed).
8. *Acacia pennata*, Willd., (moribund).
9. *Smilax* sp., (killed).
10. *Woodfordia floribunda*, Salisb., (killed).
11. *Dioscorea anguina* Roxb., (moribund).
12. *Diospyros tomentosa*, Roxb., (killed).
13. *Diospyros montana*, Roxb., (healthy).
14. *Oroxylum indicum*, Vent., (killed).
15. *Cleistanthus collinus*, Benth., (healthy).
16. *Bauhinia* sp., (healthy).
17. *Bauhinia malabarica*, Roxb., (moribund).
18. *Anogeissus latifolia*, Wall., (moribund).
19. *Streblus asper*, Lour., (moribund).
20. *Eugenia Jambolana*, Lam., (healthy).
21. *Eugenia Heyneana*, Wall., (moribund).
22. *Desmodium* sp., (killed).

23. *Desmodium polycarpum*, DC., (killed).
24. *Cassia Fistula*, Linn., (killed).
25. *Spatholobus Roxburghii*, Benth., (healthy).
26. *Ichnocarpus frutescens*, Br., (killed).
27. *Millettia auriculata*, Baker, (healthy).
28. *Dendrocalamus strictus*, Nees., (healthy) Pl. 20, Fig (2).

The incidence of disease is most marked in the immediate neighbourhood of ravines and streams with which the Division is well supplied. Consequently the regeneration has been badly attacked in the moister area especially in valleys where there is heavy canopy of climbers and therefore poorly illuminated. In Tulka, for instance, 25 per cent. of the saplings have been infected in some compartments. The lower branches in most of the infected plants have been killed with the result that the plants appear moribund. In other places there is almost 50 per cent. defoliation due to fungus attack. The advanced growth between 15 to 17 ft., though not always free from attack, appeared healthy. Poles are free from infection.

In the drier localities, on the other hand, the infection is generally confined to a small group of saplings here and there. Those that are growing in moister and less illuminated area have been infected. For instance, in Bagmunda and in Kurru blocks (Puranacote range) a few saplings have been attacked here and there. Similarly Raigoda C1, where the sal is growing on a dry slope, appeared free from infection, while in the two compartments C3 and C4 lying in a depression numerous cases of infection have been recorded.

As regards the mode of infection the following points were noted during the field study:—

1. Contact spreading of infection.—The usual mode of spreading of this fungus about this time of the year is simply by contact between infected plants which may take place in various ways (*i*) direct contact from the infected sal to healthy ones by means of branches and leaves; (*ii*) wind blown infected leaves during the leaf-fall or such decomposed leaves carried by the agency of animals, birds, etc.; (*iii*) decomposed portions of infected branches

blown by wind or carried by the agency of animals, birds, etc., and (*iv*) contact through the medium of various climbers or forest shrubs as enumerated above.

2. The axils of sal twigs appear to be important points of attack as shown by the development of mycelial cushions and necrosis of bark and also the axils of the leaves.

3. The fungus may spread from the lower branches up the main stem, which is the usual mode of attack in case of saplings about 4 ft. and over, or the dropping leader may by coming in contact with a diseased plant get the infection first which proceeds downwards and then spreads over the lower branches. In the later case the leading shoots are killed first and then follow the lower branches. This happens in case of coppice shoots and smaller saplings.

IV. *Reports on the occurrence of Sal Thicket Fungus from other Divisions.*—This disease has also been reported from Russelkunda, Ganjam, Madras Presidency, a division which is adjacent to the southern boundary of Orissa. Recently Mr. R. N. Parker, Forest Botanist, Dehra Dun, noticed this fungus near Dulani Chowki, Lachiwala range, Dehra Dun. Subsequent search was made in Lachiwala and Thano ranges, Dehra Dun, with the result that a number of cases of this fungus was observed on sal, *Hiptage* sp., *Zizyphus* sp., *Mallotus* sp., in these forests, but only three saplings of sal were noticed dying on account of the attack. In this case also such infection was observed along ravines or in the moister depression of the forests. Two cases may arise from the incidence of this disease in these forest—either the disease has not succeeded in establishing itself in the Doon forests, owing to the comparatively drier atmosphere prevailing here, or the fungus is just appearing and has not fully established itself in these areas. Further observations as well as inoculation experiments should decide which of the two propositions is correct. It will be interesting to record how far this fungus is prevalent in other sal forests. In fact, this is the primary object of this note and information regarding the occurrence of this fungus in other sal growing areas will be welcome.

V. *Identity of the Sal Thicket Fungus*.—This disease comes under the well known maladies of plants which are described in the text books of phytopathology under the popular name of "thread blights". The name "thread blight" is applied to the white mycelium which runs in well-defined strands along the living branches and leaves often at a considerable height from the ground. There are probably several distinct fungi which have been described by the name of "thread blight." In India two kinds have been observed which grow on sal, one of them is known as the "horse-hair" fungus. The mycelium of this fungus forms smooth, shining, hair like, cylindrical or semi-cylindrical or occasionally completely flattened brown or black threads which run over the aerial parts of plants on which it grows. The writer has observed this fungus in Dehra Dun forests as well as in Angul, but it is not associated with the "white thread blight" of sal known as Sal Thicket Fungus.

Outside India, "thread blight" diseases have been recorded in Ceylon, Java, and in Florida, America.

Petch (1) has recorded the "horse-hair" fungi growing on *Terminalia tomentosa* with the "white thread blight" on the bushy undergrowth. He has also observed that the mycelium of "horse-hair" blight is epiphytic and not parasitic as in the case of "white thread blight". He has described several species of *Marasmius* as causing "horse-hair blights" on tea (2).

Butler (3) has described the occurrence of sterile mycelium on the stem and leaves of tea causing death of the leaf-cells. He has noted this fungus on a large number of jungle and cultivated plants in Assam, which includes the mango, loquat, the sapodella, *Dillenia*, and the common hedge plant, *Duranta*. In the absence of fruit body he has not been able to identify the fungus, but he considers it to be a member of the Basidiomycetes. According to him neither the exact nature of parasitism of this fungus nor the range of hosts it can attack is known.

(1) Petch, T.,—Revisions of Ceylon Fungi, Part III, p. 297—298, Ann. Roy. Bot. Gds., Peradeniya, Vol. V, 1912—1914.

(2) Petch, T.,—Horse-hair Blights, p. 43—68, Ann. Roy. Bot. Gds., Peradeniya, Vol. VI, 1915-1917.

(3) Butler, E. J.,—Fungi and Diseases in Plants, p. 456—461, 1918.

He has cited two species of *Corticium*, one on coffee, *Corticium Koleroga*, Cooke, and the other on tea, *C. Theae*, Bern. as examples of such "thread blights". He considers that this disease is confined to India and it is exceedingly doubtful if the somewhat similar diseases which have been described in Java and Ceylon are really "thread blights". He (4) has also described the "horse-hair" fungus found in the jungles and tea gardens which are smooth, black, shining cords and run over the aerial parts of plants as rhizomorph of some fungus, probably a Basidiomycetes.

A marasmioid fungus causing cobweb and thread blight disease of teak (*Tectona grandis*) in Java has been described by Schwarz (5). This is apparently a species of "horse-hair blight" described by Butler (6) and Petch (7).

Corticium Koleroga, Cooke, has been reported from Florida by Wolf and Bach (8) causing "thread blight" (shoestring disease) of citrus and pomaceous plants.

Weber (9) has recently described a "thread blight disease" caused by *Corticium stevensii*, Burt. (*C. Koleroga*, Cooke) which is said to be common, though not epidemically destructive in Florida. The list of hosts reported for this fungus includes Virginia creeper, plum, soap-berry, china-berry, persimon, pistache, jujube, tung-oil trees and others.

From the above descriptions it may be seen that the correct identity of the various "thread blights" is rather obscure, but in the main they resolve into two genera of fungi under Basidiomycetes *viz.* the Marasmius and the Corticium.

(4) Butler, E. J.,—loc. cit. p. 11.

(5) Schwarz, M. Beatrice,—Spinnewebziekte bij Mahonie en Djati, Korte Meded. Inst voor Plantenziekten 2, p. 9, 1926; R. A. M. Vol. VI, p. 383, 1927.

(6) Butler, E. J.,—loc. cit. p. 11.

(7) Petch, T.,—Horse-hair Blights, p. 46—68; Ann. Roy. Bot. Gds. Peradeniya, Vol. VI, 1915—17.

(8) Wolf, F. A. and Bach, W. J.,—The thread blight disease by *Corticium Koleroga* (Cooke) Hohn, on citrus and pomaceous plants; Phytopath, xvii, pp, 687—709, 1927; R. A. M. vii, p 247, 1928.

(9) Weber, G. F.—A fungous disease of plants by *Corticium stevensii*, Burt Florida Agri. Expt. Sta. Bull 186, pp, 141—162, 1927. Abstract. Exp. Stn. Recd. No. 9, Vol. 57, Dec. 1927.

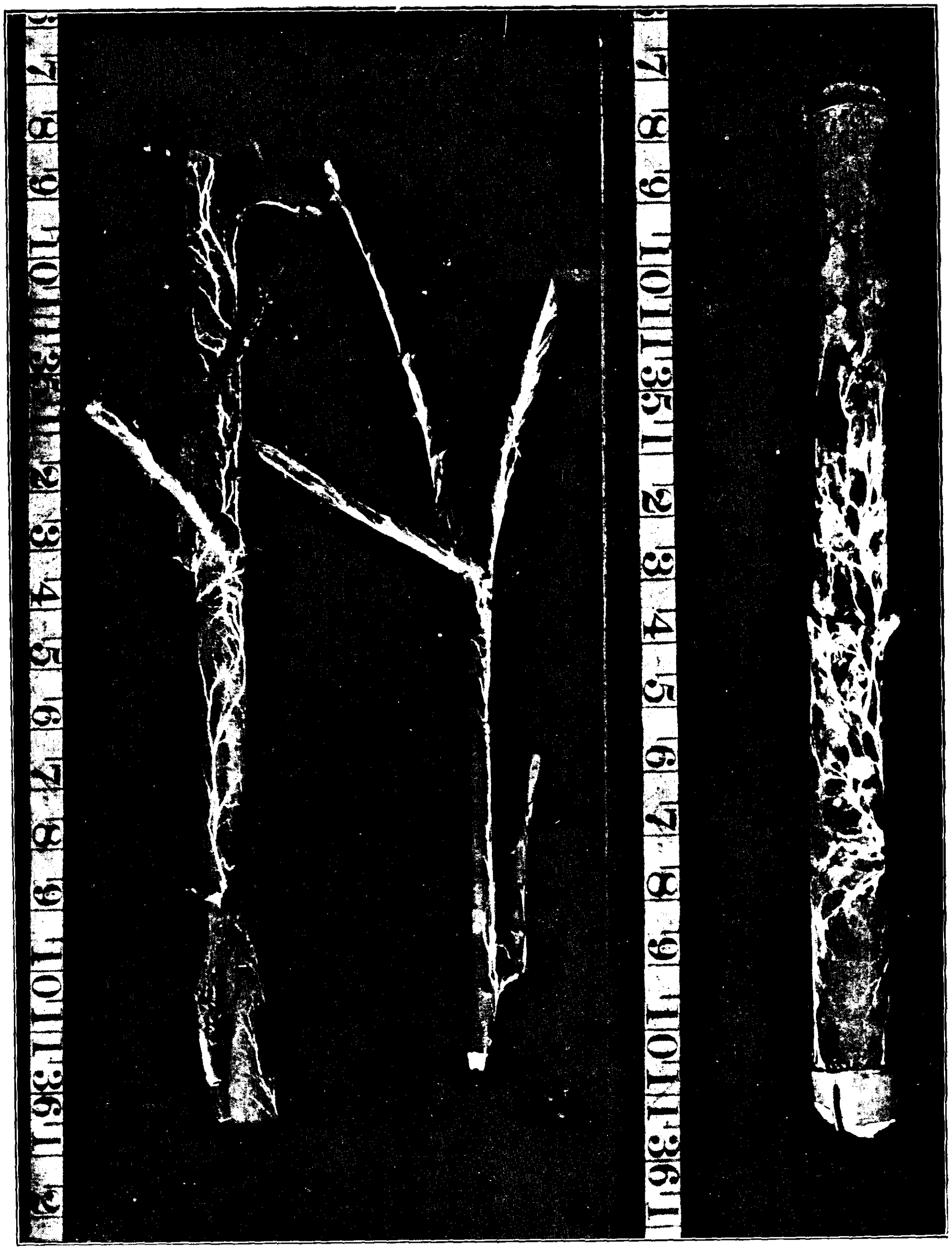
The writer has no access to the original publications, consequently it is difficult to say which of these fungi resembles more closely the Sal Thicket Fungus, but there is little doubt that it belongs to the Basidiomycetes on account of its fan-shaped manner of spreading, the presence of clamp connections in the hyphae and its cultural peculiarities. The fungus is being grown in culture for further study of its mode of parasitism by inoculation experiments and for growing fruit bodies in artificial cultures for proper identification.

VI. *Experiments on Control.*—It appears from the field study that the predisposing conditions of the disease are excessive shade and high atmospheric humidity and the communication of the blight to sal by direct extension of the parasite from the infected leaves and branches of climbers, shrubs and other trees which are associated with the regeneration in these areas. Consequently, periodic cleaning to free the regeneration of climbers and effective pruning and the burning of the infected leaves and twigs after the leaf-fall may not only help to check the contact spreading of the disease but will open out the heavy canopy of climbers over the infected compartments considerably. Besides this, controlled burning, at the proper time, as an experimental method, may be suggested in some compartment where the outbreak is in epidemic form, provided such burning does not interfere with other silvicultural operations in the area in question. This later measure will be of great advantage in certain respects in keeping down undesirable climbers and shrubs and in removing the infected slash from the floor of the forest.

The writer here wishes to acknowledge with many thanks the kind help and courtesy of Mr. O. A. Dodsworth, I.F.S., Divisional Forest Officer, Angul, during the tour and his range staff for help during the inspection of the forests.

VII. *Explanation of the Plates.*—

Plate 19. Fig. (1).—Section of sal sapling, 12ft.-13ft.; the leading shoot was healthy but a number of secondary branches have been killed ; the figure showing the mycelial cushions at the leaf bases.



Sal Thicket Fungus.

Plate 20. Fig. (1).—Sections of branches of the woody climber *Zizyphus Jujuba*, Lam. and *Bauhinia malabarica,* Roxb. both appeared moribund.

Plate 20. Fig. (2).—Sections of *Dendrocalamus strictus*, Nees.; appeared healthy.

THE REGENERATION OF TROPICAL EVERGREEN FORESTS. (RAIN FOREST.)

By H. G. Champion, Silviculturist, Forest Research Institute.

1. Introductory.

There is unfortunately as yet no generally accepted classification of forest types, with standardised nomenclature and definitions such as would enable one to allot a given forest area to one or other recognised type without further explanation. Every one would probably agree that certain forests were good examples of the type referred to in the title of this note, but many other forests would be included in it by some and excluded by others. In India, we have plenty of classifications, but they are all local, as is apparent from Troup's summary in the Introduction to his "Silviculture of Indian Trees".[1] Tropical evergreen or "rain" forest is generally what is termed a climax formation, and in its typical form, as in the Western Ghats, Assam, and Tenasserim, is readily recognised as such; the difficulty is to draw the line between it and other forms of moist mixed forest which also generally have a large proportion of evergreens, whilst some of their conspicuous species may also be freely met with in unquestionable rain forest, notably some Dipterocarps, *Tetrameles*, etc.

Troup[1] (*loc. cit.* p. xxxiv) drawing on Schimper[2] (*loc. cit.* C.I.V. pp. 284-344, especially "Asia" pp. 293-99), describes its main characteristics thus:—"Rain-forest is the evergreen forest characteristic of warm tropical regions with heavy rainfall and high atmospheric humidity. The rainfall is at least 80 inches, but is often much greater. The dry season is usually not prolonged, or where there is a prolonged dry season, this forest

occupies moist situations. The vegetation is luxuriant, the forest often consisting of two or more tiers, the trees of the highest tier being at least 100 feet high and often much taller. The species are very numerous and are chiefly or entirely evergreen; gregariousness is strikingly absent. Many of the trees have plank buttresses at the base; they have as a rule comparatively thin smooth bark and are only sparingly branched. The leaves are of very diverse forms, often firm, leathery and glossy, seldom finely pinnate or with a thick covering of hairs. The forest is rich in thick stemmed climbers, climbing palms and woody as well as herbaceous epiphytes."

This description, to which may be added the remarks that bamboos are typically absent or inconspicuous and that cauliflory is common, gives a fair idea of the type of vegetation in question, but again gives no lower limit, for the next type contrasted with it is the predominantly deciduous monsoon forest with a marked dry season. Intermediate forms find mention in some accounts such as the "wet mixed forest" of some Bengal Working Plans[3], and the "sub-evergreen" in Tenasserim[4], but these appear to be inferior types compared with the rain forest proper, and it is suggested that they are of recent origin due directly or indirectly to human interference (*taungya*, fire protection, etc.). This leads to the view that they may themselves be only transitory and may ultimately progress or revert to forms more like the true rain forest. With ascending altitudes in the hills, tropical evergreen merges into sub-tropical and temperate evergreen forests beginning at 2,500 feet to 3,500 feet according to latitude and other local factors. The great height of the trees of lower elevations is lost and the constituent species are different, *Cupuliferae* (*Quercus* and *Castanopsis*), *Schima*, *Eurya*, and some of the smaller bamboos being particularly characteristic, though *Lauraceae*, *Eugenia*, and *Magnoliaceae* are equally typical of both.

In this note, unless it is stated to the contrary, only the pronounced tropical evergreen or rain forest is under discussion.

Whilst primarily a climatic climax, rain forest is not entirely independent of edaphic or soil conditions, and under identical

climate, parts of a forest tract which is mainly evergreen, may be definitely mixed deciduous. This can usually be traced to soil and exposure differences, and is the more frequent the nearer climatic conditions are to the lower limit permitting development of rain forest. Even well within the limits, there may be considerable variety, at least in hilly country, and one cannot say that any one type is the climax for the whole area as has been pointed out in Shreve's[5] study of the rain forest of the West Indies (*loc. cit.* p. 106). In most areas where rain forest is found, there will be low lying strips where a rather different flora prevails, the genus *Lagerstroemia* being particularly typical. This riverain forest—as also the allied freshwater swamp form—is usually easily recognised though much mixed up with the other.

2. The Synecology of Rain Forest.

It is obvious that the conditions of life in such forests are very different indeed from those prevailing in the opener, more xerophytic types which occupy the greatest area in India and the world generally. Although the more precise nature of the differences and their extent and significance has been made the subject of special studies in several countries, we still know very little about it.

It may be noted that the intensity of the light in the middle canopy is about $\frac{1}{25}$ of the full incidence, whilst on the ground it is only $\frac{1}{410}$ (Allee[6]). Relative transpiration seems to be about the same for the plants grown in the shade as for all other vegetation, but as the atmosphere is constantly humid, the absolute transpiration is low.

Considering the regeneration of the important timber tree species, perhaps the most influential feature is the range of conditions it must pass through from the germinating seed lying on a thick layer of rotting vegetation in a nearly saturated atmosphere with the weakest of light, *viâ* the small seedling competing with herbs and creeping shrubs still in deep shade and with abundant moisture, *viâ* the pole or sapling fighting its way into the middle canopy with rather less humid atmosphere, but more

light, to the top canopy where it is exposed to the sun of the tropics and winds which may be relatively dry. Conditions may be decidedly xerophytic in the top storey, as is indicated by the nature of the foliage and the fact that very many top storey species are more or less deciduous. The studies quoted have; not unnaturally been made mainly on the lower strata of vegetation, the giants of the forests almost defying investigation on ordinary lines, but not a few features are common to all strata. Thus it appears that the rain forest is very little dependent on the soil, which may be shallow even to an extreme, and when exposed to light and air, what we should call a very poor one; the forest has apparently evolved a system of living largely on the products of its own decay (McLean[7]). Though the soil underlying many of our forests is undoubtedly good, it may be remarked in most, how the trees spread over the rocky outcrops which get re-exposed very rapidly on destruction of the continuity of the canopy.

3. Distribution of Tropical Evergreen Forest.

It has been seen that the distribution depends primarily on the two factors of temperature and rainfall. Temperature requirements are fulfilled throughout the tropics up to an altitude of 2–4,000 feet according to latitude, and in considerable areas outside the actual tropics. The rainfall necessary for its development is not only considerable, but must be well distributed, for there are many districts where the annual fall is well over the quoted 80 inches, but where the vegetation remains of the typical deciduous or monsoon types, and is associated with a period of deficient moisture. The greater the rainfall, the more dominant the evergreen type becomes, and few areas with over 125 inches reasonably distributed are without it. The nearer the equator and the higher the mean temperature, the shorter the dry interval which will inhibit the development of the typical evergreen forest. On the other hand, where the rainfall or its distribution are near the limiting figures, situations favourable to the retention of moisture such as sheltered hollows and damp stream banks, also favour the development of this type, in fact in the plains forests of North Bengal, much of Burma and

elsewhere, it is confined to such places. Prevalence of fog increasing humidity and reducing insolation may permit the development of rain forest with a much smaller rainfall (even down to 44 inches near Rio-de-Janeiro[7]).

Extensive rain forests are met with in the Amazon basin and adjoining parts of South and Central America, the West Indies, the West Coast of Africa, the West Coast of India, and a big tract of South-East Asia, including the Philippines where upwards of 75 per cent. of the forest area and 95 per cent. of the timber is of this type.

In India, it is well developed on the West Coast and in the moister parts of Burma, in Chittagong, Arakan, the Andamans, and the Eastern Sub-Himalayan tract and lower hills, showing on the map an outline very similar to that of the over 90 inches rainfall areas excluding the higher hills. It will be noticed that Madras, Bombay, Bengal, Assam, Burma and the Andamans—well over half the major provinces, come into contact with the evergreen problem. We shall have occasion to refer to the following six regions irrespective of political boundaries :—

(*i*) West Coast.

(*ii*) E. Himalaya (North Bengal and N.-W. Assam).

(*iii*) S. Assam (Sylhet, Cachar).

(*iv*) Chittagong and Arakan.

(*v*) Burma and Upper Assam.

(*vi*) Andamans.

It might be preferred to distinguish the Upper Burma and Assam occurrence from the Southern Burma and Andamans, but it is convenient to deal with the Andamans separately, and Upper and Lower Burma are then best taken together.*

4. Composition.

The general characters of rain forest have been given above, and a few further notes are required as to the actual composition

* This view finds support from Burma Forest Officers, but the writer has not yet discovered where the line is to be drawn across the Salween Valley linking the typical north and south occurrences.

in the Indian and Burma examples. The Dipterocarps are undoubtedly the most striking feature, especially the genus *Dipterocarpus* (*vide* Troup[1] p. 32) though several species are actually more or less deciduous, and extend freely into the moist deciduous types. The West Coast has only one species, *Dipterocarpus indicus*, which does not occur elsewhere, and there are none in the East Himalayan area, but the immense height to which they attain and their strikingly fine boles attract attention wherever they occur. Important also is *Hopea* with closely allied species in Burma and the West Coast. The several Dipterocarps tend to be social, and their presence or absence on any spot is very hard to explain. The *Leguminosae* are much less well represented than in Africa and the New World.

Calophyllum (in closely allied species) and *Mesua ferrea* are important timber trees met with practically every where in the evergreen forests of India though varying greatly in frequency. *Artocarpus* in several species is again very characteristic, *A. Lakoocha* occurring in all 6 regions, *A. hirsuta* and *A. integrifolia* belonging to the West Coast, and *A. Chaplasha* being absent only from the last mentioned area. Other well-known trees frequently met with in all our evergreen forests are *Sterculia alata*, *Acrocarpus* and *Tetrameles*, *Cedrela Toona*, and *Chickrassia*, all tending to be more or less deciduous, and the first three reaching immense size with strikingly developed plank buttresses. *Eugenia* spp., *Mangifera*, *Diospyros*, *Myristica* spp., and *Myrtaceae* are also very generally common evergreens, whilst such trees as *Bischofia* and *Lagerstroemia Flos-Reginae*, which characterise wet soils, also occur throughout. Not a few species tend to be confined to the more southern parts, the West Coast and Burma, such as *Antiaris* and *Holigarna*.

The great richness of species is a pronounced feature of tropical evergreen forests and one of considerable practical importance, for it results in the scattering of any given species by single trees or groups over a wide area, and this means difficulties and waste in working unless markets are available simultaneously for a large variety of species. How complex is the flora may be illustrated by the following average figures per 100 acres collected

for a fairly typical area in Coorg (Tireman[15], p. 18) for trees over $6\frac{3}{4}$ feet girth only. Lists from Madras are very similar.

	Per cent.		Per cent.
Vateria ...	26 = 9·1	*Acrocarpus* ...	2 = 0·8
Hardwickia ...	23 = 8·0	*Mesua* ...	2 = 0·7
Dipterocarpus indicus	14 = 5·0	*Mangifera* ...	1 = 0·5
Dichopsis ...	$6\frac{1}{2}$ = 2·3	*Eugenia* ...	1 = 0·5
Hopea ...	6 = 2·2	*Artocarpus hirsuta*	1 = 0·5
Calophyllum ...	$5\frac{1}{2}$ = 2·0	*Diospyros* ...	1 = 0·4
Bombax ...	3 = 1·0	*Dysoxylum* ...	1 = 0·3
Cedrela ...	3 = 1·0	*Artocarpus integrifolia*	1 = 0·3
		Tetrameles ...	1 = 0·3

5. Local Forms.

Whilst great similarities in general facies and ecological conditions, and not a few characteristic species (or better still, genera or sub-genera) are met with wherever the type occurs, each of the 6 more or less disconnected areas distinguished above shows certain features and trees peculiar to itself, or at least shared only with some of others. Variations in local conditions, mainly connected with the stage of "opening up" of the country reached in each case, also result in the forestry problems bearing somewhat different aspects from place to place.

(i) *The West Coast.*—The West Coast forest flora[15 16], though presenting as we have seen many features in common with the other areas, differs considerably more from them than they do among themselves, a fact which may well be traced to their different geological history and relative isolation. Dipterocarps are local, *Hopea parviflora*, *Dipterocarpus indicus* and *Vateria indica* being the chief, *Mesua*, *Hardwickia pinnata*, *Calophyllum* and *Artocarpus* are the chief timbers of better quality, whilst *Acrocarpus*, *Dysoxylum malabaricum*, *Polyalthia* and *Elaeocarpus* may be mentioned among saleable soft woods, with *Cullenia* and *Dichopsis* as of small value but often abundant. Compared with the other evergreen forests, those of the Western Ghats are perhaps not so infested with cane brake though climbers and epiphytes are abundant enough, and

they have been very severely reduced in extent and quality by shifting cultivation and other agencies, as will be discussed later. Gregarious patches of "eta" reed (*Ochlandra* spp.) are a special feature in the south: their occurrence and origin require study.

(ii) *The Eastern Himalayan Area* [3, 17].—It is questionable whether Upper Bengal and the adjoining parts of Assam have any true tropical evergreen forest, and in any case, it is restricted to favourable spots scattered among the mixed deciduous forests. There is evidence that considerable changes have taken, and are taking place in this area, and it is possible that the true climatic climax is tropical evergreen over a larger area than is at present apparent. Dipterocarps are absent the chief species being *Æsculus, Eugenia, Artocarpus Chaplasha, Cinnamomum Cecidodaphne, Talauma, Echinocarpus, and Duabanga.* Much of the area of heaviest rainfall is in the hills, and though mainly under evergreen, the forest is of the temperate form with oaks and *Castanopsis* predominating. There is no marked break between this area and Upper Assam, but the latter appears more closely allied to the Burma region.

(iii) *S. Assam* (*Sylhet and Cachar* [18]).—This area lies round the Khasya and Garo Hills being virtually continuous with the Chittagong Tracts, but partly separated from Upper Assam by a belt of less rainfall to the lee of the hills.

The important trees are *Mesua, Artocarpus Chaplasha, Michelia Champaca, Cinnamomum Cecidodaphne, Aquilaria Agallocha, Dipterocarpus turbinatus, Talauma, Calophyllum, Kayea,* etc. There is relatively little cane or palms and climbers, but ephiphytes are very numerous.

(iv) *Chittagong and Arakan.*—This is a strip running down the Arakan Coast from the Ganges to the Irrawaddy delta; it is continuous with the Sylhet area, but is separated from the Eastern evergreen tract of Burma by the region of less rainfall east of the Yomas. As expected, the chief trees [19, 20] are very similar to those of Central Assam, but several species of *Dipterocarpus* (*garjan*) become conspicuous, as well as other species more typical of the South-East. The chief species in the Arakan forests is *Buchanania lancifolia, Mangifera*

Sylvatica being also common. *Hopea* occurs rarely, and the occurrence of *Dipterocarpus tuberculatus* (*in*), which is not associated with evergreen forests in other parts of Burma, is noteworthy. The *garjan* may form nearly pure forests which are not then included in our tropical evergreen type. This area, too, has been very greatly altered by shifting cultivation.

(v) *Burma and Upper Assam.*—The Burma area[13] is by far the largest continuous area of tropical evergreen forest we have, and is itself only the northern part of the big tract taking in all the Eastern side of the Western Peninsula down to Singapore. *Dipterocarpus* spp., *Hopea odorata* and *Parashorea stellata*, *Anisoptera* and *Shorea assamica* (the last in the North only) are the chief Dipterocarps, associated trees of the top storey being *Sterculia alata*, *Tetrameles*, *Acrocarpus*, *Pentace*, etc, whilst *Artocarpus Chaplasha*, *Albizzia lucida* and *Mangifera* must be mentioned. *Pentace*, *Parashorea* (in the south only) and *Shorea assamica* are examples of conspicuous trees not met with outside this area. A very valuable study of the type from the forester's point of view has recently appeared in H. C. Smith's Working Plan for a part of South Tenasserim[4].

Stamp[14] separates the southern form under the title "Evergreen Dipterocarp forest," from the northern "wet evergreen (Northern) type;" on the grounds of the absence in the latter of many of the typical Dipterocarps (*e.g.*, *Anisoptera*, *Parashorea*) and the relative prevalence of *Meliaceae*, *Michelia*, etc., and *Dendrocalamus Hamiltonii*.*

(vi) *Andamans.*—The evergreen forests of the Andamans[20] are generally similar to those of Lower Burma, especially those of Tenasserim. They tend to be confined to the ridges and upper slopes of the hills and a micaceous sandstone favours their growth more than other soils do. There is a dense undergrowth of canes, including the climbing bamboo, *Dinochloa andamanica*, in fact these forests probably include the densest we have (Roger[21]). There appears to be a number of species peculiar to the islands, including

* This view finds support from Burma Forest Officers, but the writer has not yet discovered where the line is to be drawn across the Salween Valley linking the typical north and south occurrences.

some of the more conspicuous such as *Planchonia andamanica* and *Garcinia andamanica*, but as our knowledge of Tenasserim increases, it appears likely that the number of these will be reduced. The better known examples of *Terminalia Manii* and *Terminalia bialata* do not belong to the evergreen forest.

6. Destructive Agencies, Past and Present.

The first time one encounters tropical evergreen forest it appears unconquerable On longer acquaintance, one learns that not only is it quite vulnerable, but that its extent has already been enormously reduced, and its facies very greatly influenced by human activities. The large areas cleared for rubber, coffee, etc., are obvious, but a far greater proportion has been destroyed or altered beyond recognition by shifting cultivation, the most striking examples being perhaps the northern end of the Western Ghats[22], and the hill tracts between Assam and Burma. So extensive have been these operations and so long have they been in action, that it is not always easy in many cases to be sure whether the existing forest is of the type that originally occupied the ground or not, for although a small clearing is very soon swallowed up by the evergreen forest on being abandoned, the process for extensive clearings is most certainly a very slow one of long but quite unknown duration (Smith,[4] p. 39).

Areas that are taken up for permanent cultivation of any kind cease to be forest, and no longer directly interest us, but all other forms of utilisation or destruction bearing on the evergreen forest, which leave the area still actually or potentially forest, require close study. Among these may be enumerated :—

1. Timber felllings concentrated on one or few species.
2. Heavy logging operations.
3. Long-interval jhuming.
4. Short-interval jhuming.
5. Lopping, grazing, burning, etc.

A possible sixth agency would be progressive climatic changes.

7. Residual Areas.

It is impossible to give figures with any pretence to accuracy for the areas still under primary tropical evergreen forest in the six regions recognised. Even had all our forest divisions been adequately stock mapped, there would still remain the large areas belonging to private owners and tn the Indian States (notably Travancore).

The nearest approach to such an estimate in square miles which is available is 23,000 square miles of Government Forest and 1,860 square miles of private forest.

8. Natural Regeneration.

In some ways, the conditions under which tropical rain-forest grows are optimum for plant development. The two factors on which most depends are warmth and adequate moisture supplies, and these, as well as light incidence per square foot, are all highly favourable. True the tallest and biggest trees on record are not found in this type, but in the more temperate coniferous forests of North America and in the Eucalyptus forests of Australia, but trees magnificent in height, girth and bole are a feature, and the total amount of vegetation per acre is undoubtedly much greater. Possibly the superiority of the *Sequoias* and *Eucalyptus* may be connected with a stronger transpirátion current due to less humid air and abundant subsoil water supply, or to rather better soil conditions.

On the other hand, the internecine struggle for existence is at its very greatest, and a high degree of co-ordination to the very special factors of the environment is essential if a given tree or tree species is to propagate its kind. Once in the main canopy, a tree has only an occasional lightning stroke or cyclone to fear, and escaping these, usually lives till old age ultimately weakens its vitality to such an extent, that fungi and similar agencies can no longer be resisted. True there is a chance of getting smothered or weighed down to the breaking point by climbers, but this rarely happens to the top storey trees. But to reach and keep a place in the main canopy is an end exceedingly difficult to accomplish.

The commonest starting point is to produce large quantities of rather heavy seed which fall to the ground near the mother trees and germinate with a considerable supply of nutriment available to them—moisture being abundant enough, but space in the soil, and light for carbon assimilation being both very deficient. The seedlings must be able to persist even if they do not grow, at least long enough to be replaced by others. In some, (*Dipterocarpus turbinatus*, *Artocarpus Chaplasha*) the powers of persistence are great, and the seedling very gradually forces its way upwards, though still with little hope unless chance happenings give it more light. A place in the sun is only attainable (for trees—climbers have other ways of getting it) when through the agency of old age, of the weight of climbers pulling down a tree or stripping its branches, or of lightning, cyclone or man, a break is made in the canopy, and then the race is to the swift and the strong. Only under a fortuitous combination of favourable circumstances particularly as regards season, would new growth from fallen seeds stand a chance against pre-existing seedlings. In so far as it is not invaded by creepers, the gap will first be filled by those seedlings which have the greatest powers of withstanding shade without thereby losing the power to respond at once and beyond others to the inrush of light. There will be a desperate struggle for life and room even within a few months and it will continue without loss in intensity till the spot is no longer recognisable as ever having been such a gap : perhaps three trees were removed from the canopy and probably 3, at most 5 or 6 again occupy the space, though during the process described they may not be the first to have topped their neighbours.

We should accordingly expect that among the bigger trees, the commoner species would at all times be represented fairly freely in the lower strata. The question of the regeneration of these forests has been particularly studied in Cachar (Owden[23]), and in the logging areas in Coorg and Madras, and the outcome bears out the suggestion just made, *i.e.*, that there is as rule plenty of small regeneration of the most important species, but that middle size plants are rare except in and around chance gaps.

In Cachar, specimen trees of 26 species are under observation, and in practically every case plenty of seedlings can be found; representative species which may be mentioned are *Dipterocarpus turbinatus*, *Artocarpus Chaplasha*, and *Podocarpus neriifolia*. In the Karian Shola, Madras, there is no shortage of seedlings of *Hopea* near seed trees, whilst *Mesua* seedlings are scattered throughout. At Chenat Nair (Madras) a strip of 4·4 acres enumerated in December, 1923, showed the following surprisingly large numbers per acre:—

	Seedlings up to 9″ girth.	Small trees.
Cullenia	2,620	17
Dichopsis	2,610	28
Dysoxylum	1,940	83
Diospyros	326	1
Myristica	133	2
Garcinia	115	40
Holigarna	115	...
Calophyllum	93	3
Mesua	85	...
Hemicyclia	68	32
Hopea	1	...
Miscellaneous	1,150	72
	8,256	278

Another 14 acres enumerated for all seedlings (mostly quite small) under 9 inches girth showed per acre 58 *Mesua* and 39 *Calophyllum*, 1,210 *Dischopsis*, 955 *Cullenia*, 800 *Dysoxylum*, 207 *Diospyros*, etc., though these figures are certainly above the average. Similarly at Makut in Coorg, seedlings of the 3 chief species, *Dipterocarpus indicus*, *Calophyllum* and *Hardwickia*, can generally be found in fair numbers, and the first and *Hopea* sometimes in dense patches. *Hopea* in Jalsur East (South Mangalore) was sufficient to permit of conversion of over 100 acres to a

virtually pure crop. At Papanasam in Tinnevelly seedling regeneration of *Hopea* and *Balanocarpus* is good, whilst seedlings of *Filicium, Nephelium*, etc., are extraordinarily abundant.

Areas that have been less intensively studied are doubtlessly similar in this respect, so that it may be taken that small seedling regeneration of all the species adequately represented in the existing crop is present in reasonable quantity, but that poles and saplings, and all age classes up to attainment of full height will be relatively deficient in all unworked forests of this type. It must, however, be noted that in Tenasserim things seem to be rather different (Smith,[4] p. 21), for seedling regeneration is reported to be at least not abundant, though sometimes dense crops of young saplings occur ; small gaps appear to fill up quickly, but larger ones due to windfall or exploitation are rapidly occupied by an impenetrable mass of creepers through which the forest trees appear to be unable to grow.

9. CHANGES FOLLOWING CLEARING OR HEAVY FELLINGS.

As has been stated above, Nature's method of regenerating these evergreen forests is a very gradual and inconspicuous one. Small gaps in the mature or overmature overcrop arise, extending over the space occupied by say 2 or 3 full-grown trees—perhaps 50-60 feet across—and from among the thousands of smaller plants and tree seedlings existing in them, a certain number get up and cover the ground once more. This regeneration thus arises from plants which have started life under a dense shade and have persisted under it for varying lengths of time, and it comes up with a good deal of side shade and protection from excessive insolation, and from a dry atmosphere. In any case the surrounding dense forest prevents any appreciable drying out of the soil in the biggest gaps likely to occur.

The opposite extreme is clear-felling of areas of appreciable size, and from what has been said, it would not be surprising if the very different conditions prevailing were totally unsuited to the development of the pre-existing seedlings. I know of no recorded example where the result of simple clear-felling has been followed for any length of time, though a 25 acre plot at Makut

Coorg, was girdled in 1919 and then left untouched and some plots have recently been started in Madras. The progress of events in heavily logged areas suggests clearly enough what to expect. Examples of this are to be seen in several places on the West Coast, notably Makut and Chenat Nair, where such operations were begun about 1920. These areas present two factors compared with the clear-felling which are more favourable to regrowth with the same evergreen type, in that at least some shelter is provided by the unfelled inferior species, and some seed trees of the better species are left intentionally or as unfit to fell. The most striking feature in the few years that have elapsed since the fellings at Chenat Nair is the occupation of the ground by quick growing soft-wooded species often deciduous, such as *Trema*, *Macaranga*, *Callicarpa*, *Erythrina*, *Acrocarpus*, etc., and the failure of small plants of the more valuable species, particularly *Mesua*, to respond quickly to the increased light and space. Another noticeable point is that rocky outcrops which were completely covered over by the crowns of the trees and a layer of soil and ground vegetation, are laid bare. The general indications are that the evergreen forest will be replaced by a shortlived deciduous less tropophytic type which will very gradually give way to evergreen once more, but evergreen probably poorer in the best species than the original. Chenat Nair evergreen forests are a good deal intermingled with the mixed deciduous type, being near the eastern limit of the wet coastal strip. Makut on the contrary is in the heart of it, and conditions are rather different. The first fellings were perhaps less drastic and the chief species—*Dipterocarpus indicus* and *Hopea*—better adapted to the change, and the felling areas bid fair to become in time restocked with a more valuable forest than was felled—but much assistance has been given as will be described later. The more usual history of the felled evergreen forest area is that all that will burn, is burnt, and agricultural crops are sown on the rich ash-manured soil which is then cultivated for a longer or shorter period. Crops are taken off for 1, 2 or rarely more years till the richness is lost by removal as crops or by leaching and erosion, and then the area is abandoned once more. Under natural conditions, the ever-reen forest is never exposed to fire, cannot be fired in fact, so

that trees have no need to be, and actually are not resistant, to fire injury[24]. Further, every endeavour is made to get as severe a fire as possible in order to get a clean burn such that the agricultural crops will have little to fear from coppice shoots and weed growth. Such treatment naturally annihilates practically the whole of the original forest except for a few big trees too troublesome to fell, and it leaves an exposed altered soil unsuitable for re-establishment from seed of many of the original typical species, even if the seed reaches the area. Where these practices prevail on hilly ground—and much of the evergreen zone is such—extensive erosion is also common. This procedure has completely altered the vegetation over large areas, so much so that it is not easy to reconstruct the original limits of the tropical evergreen type. It has been suggested with good reason that much of the vast areas mainly under the bamboo *Melocanna* in the Chittagong—Arakan regions were once evergreen forest; whilst in Bombay a very degenerated evergreen scrub is all that is left over large areas. From what can be seen in India and in other countries (Chipp 11, p. 60), it is evident that if such areas are left to themselves once more, there is a gradual return towards the climax, but whether it is ever reached, and if it is, how long the process takes, is known to none. In South Tenasserim, all the "giant-evergreen" forest below 500 feet has been destroyed by shifting cultivation and its place taken partly by a "sub-evergreen" type with or without bamboos. When the latter are present, there is no distinguishing line between this and moist deciduous forest thus indicating the usual tendency towards the drier type. When bamboos are absent, there is a dense mass of canes, etc., and if nothing is done, "it is likely to be hundred of years before a full tree crop is restored" (Smith 4, p. 39). Further south, however, there are large areas of virgin forest over the lower ground also which should be suitable for *taungya* operations if it does not ultimately become more valuable for permanent cultivation. In South America, McLean 7 has commented on the "failure of the forest to regenerate quickly on *large* cleared areas," and suggests that "the change brought about by clearance is probably largely due to the drying out of the humus colloids and the killing off of

the microflora," or "where the rainfall is exceptionally heavy, to the bodily removal of the soil or its nutritive contents by the rain when once the protective leafy cover is cleared off."

10. SELECTION FELLINGS.

With the evergreen, as with the mixed deciduous forests, it has often happened that only one or two species of the scores available are in any demand, so that fellings are concentrated on these, the remainder being left standing. Good examples of this are *Mesua* in Assam, and *Calophyllum* and *Hopea* in the Ghats. With the development of markets, a further series of species is coming into demand notably the soft Dipterocarps, *Dysoxylum*, *Terminalia myriocarpa*, etc., whilst the supplies of the longer appreciated timbers have dwindled. A knowledge of the results of these older fellings would be valuable, but few convincing records exist. The small reserve of Jokai (6 square miles) in Assam near Dibrugarh, was brought under a Working Plan in 1910, mainly with reference to its *Mesua*, after fellings under a 7 feet girth limit had removed all the big trees. Here enumerations over the best 700 acres showed $\frac{1}{4}$, $2\frac{1}{2}$ and 11 trees per acre of girth classes over 6 feet, 4—6 feet and 2—4 feet respectively, with relatively plenty of still smaller stems; but this can hardly be considered good stocking, and it looks as if the species was at best maintaining its position. In any case, however, much of this area is hardly typical rain forest.

In the absence of information from plots under regular observation, the matter may be considered on general lines. It has been seen above that as a rule regeneration of the important species is commonly plentiful and often tends to come up freely close to, if not under, the parent trees. When the latter are felled it is therefore likely that regeneration of the same species is well represented relatively to its competitors, and therefore has a greater chance of occupying the gaps formed by the fellings. The Dipterocarps, especially *Dipterocarpus turbinatus* and *Hopea* are good examples of this, whilst *Mesua* regeneration tends to be more scattered. There will, however, always be cases where the gaps are seized by other species, particularly if the gap is small and readily covered in by the surrounding already well established

rees, so ground must be lost in the long run, but the semi-gregarious habit of the Dipterocarps may possibly be traceable to the general success of the method.

Another point that is perhaps not always realised, is that when a girth limit of say 7 feet is fixed for felling, one is usually felling a large amount of overmature stock representing perhaps twice or thrice any ordinary rotation age, and it is not to be expected that the next lower class, say 6-7 feet can rapidly replace the trees removed, even if it is present in normal quantity as seems rarely to be the case. This is so apart from the fact that the girth increment of many of these tree species is commonly not as rapid as supposed, particularly for the hard woods. A girth of six feet in 90 years has been estimated for *Mesua* in Assam and *Dipterocarpus* species in Cox's Bazar grow about 1 inch girth a year up to 10 feet.

Finally, the removal of most of the seed trees results in a great reduction in the chances of the selected species gaining a place in the chance gaps which Nature provides.

It thus appears that selection fellings concentrated on few species, if no special measures are taken, must result in a steady if slow reduction in the proportionate representation of those species, and that after first fellings the number of exploitable trees per acre must show a great falling off never to be regained.

(*To be continued.*)

PIDAUNG PLAIN GAME SANCTUARY, MYITKYINA DISTRICT, BURMA.

The Conservator of Forests, Hlaing Circle, Burma, sent us the following interesting extract from the diary of Mr. H. C. Smith who is the Burma Game Warden. The account deals with the Pidaung Plain Game Sanctuary, Myitkyina District :—

* * * * *

April 27th.—Moved camp to Pidaung station, 4 miles 6 a.m.—8 a.m.

Leaving camp at 5.30 a.m. I struck northwards more or less along the edge of the jungle for about two miles. Several peafowl

were calling along the Changnam Ilka and I flushed one bird. The plain was looking at its best with the *lettok* flowers in full bloom and the sun shining on the young grass which was bright green after the rain of the last few days.

At 7 a.m. I watched two sambhur stags fighting for about a quarter of an hour from a distance of about 30 yards, near the spot where I photographed a herd of bison with the Chief Conservator of Forests last year. One stag was much bigger than the other and they were sparring in a playful kind of way rather than fighting. Owing to the wind and a slight screen of bushes I could not photograph them actually with their antlers interlocked but eventually they broke away and the bigger stag walked straight up to me when I photographed him.

We continued northwards a little further and then swung round and headed for Dayemaw *it.* A solitary stag hog deer with horns well grown in velvet stood and watched us. Then we saw a sambhur hind and one or two more hog deer.

At 8-30 a m. on a slope, bare save for a few stunted *lettok* trees, we saw two tigers about 60 yards in front of us. One was stretched out asleep at the foot of a tree and the other was right out in the open and seemed to be stalking a hog deer which was feeding about 100 yards away to our right front. The hog deer on becoming aware of either us or the tiger bolted, and the tiger seemed rather bewildered at first. Eventually he saw us and then was most interesting to watch. Instead of bolting straight off across the open, over the rise away from us, as a deer or most other animals would have done, it deliberately crawled very cautiously down the slope towards us for about 15 yards, to gain the cover of a small patch of scrub which ran along the depression which separated us. Once in that it "froze" for about five minutes. The other tiger all this time was sleeping on in full view, but apparently oblivious of our presence. Eventually the first tiger emerged from the cover again and walked up to and past the other one, which woke up and looked round in a dazed sort of way. I took one photograph of the two together and three other photographs of the two singly. Finally the fact that five people and a dog were standing absolutely in open gazing

at them proved too much for them, and one after the other they marched off slowly to our left taking advantage of every bit of cover and only breaking into a trot when within a few yards of some thick jungle about 150 yards away. It was a most interesting half hour.

This naturally brings up the question as to whether or not tiger should be protected in the sanctuary, and I consider that generally speaking they should be. If, however, it is found that they are becoming too destructive and game is being unduly reduced in numbers then a few should be shot. The game watchers say that there are eleven tigers in the reserve, but some of these are sure not to stay there permanently. I think the matter should be left in the hands of the Game Warden, who would be guided by the results of his own inspections and the advice of the Divisional Forest Officer and the Game keepers. If he considers the killing of any tigers necessary, then he should be authorised to arrange for their destruction as he thinks fit. A keeper said that about a month before he had seen these same two tigers stalking a *saing* in the north of the sanctuary near the Kasun Chaung.

Continued our walk to Dayemaw *it* and then struck north eastwards again towards Kasun Chaung.

At 11 a.m. we roused a small pig which was rootling about by itself in a small isolated patch of jungle. It bolted off across the open. We then came upon that morning's tracks of a large herd of bison moving northwards. Heard elephant and peafowl in the rather dense unburnt jungle to the north. It soon started to cloud over and a drizzling rain set in.

At 2 p.m. we came up to a herd of about 15 *saing*. The animals were alternately slowly resting and feeding and seemed very suspicious. I took one poor photograph of them before they trotted off northwards.

At 2-30 p.m. I had a most interesting and amusing encounter with a herd of 10 pigs. It was raining slightly and there was a fairly strong and steady breeze blowing. The pig walked right up to me in very open jungle looking at me and grunting as I

took three photographs of them; one was at about 8 yards distance. They then cleared off into light scrub about 50 yards away and continued feeding. I followed them and watched them for about half an hour afterwards, but did not take any more photos. There was no big boar in the herd.

Continuing we roused another solitary pig, and then watched a stag hog deer in velvet lying down in a small clump of trees.

At 4 p.m. we reached the Ma Naw lick near the Kasun Chaung road. Took a sample of the earth and some photographs of several hog deer grazing out in the eastern end of the *lwin*.

Started back along the Pidaung-Kasun Chaung path. The rain cleared off and it was a perfect evening.

At about 5-30 p.m., near the 6th mile, I saw a solitary bull *saing* away to the east of the path. Following him I took two photographs from about 40 yards as he was walking towards me. When I released the shutter the first time, he wheeled, trotted round in a circle and pulled up again in almost exactly the same place. I then took another photo, and this time he turned and trotted slowly away for good. He was a fine animal with a rich red coat and whitish face.

Cutting back to the path we continued towards Pidaung, and between the 4th and 5th miles found a small colony of the large Swallow Plover, *(Glareola orientalis)*, breeding within a hundred yards of the path on the west side. In about a quarter of an hour we found 4 clutches of eggs which were laid in hollows in the ground with no nest. As far as I know these birds have not been recorded, at any rate as breeding, from this part of Burma before, and they should be strictly preserved.

Whilst we were looking for these eggs a herd of *saing* containing one particularly good bull was moving up towards us from the west, but by this time it was nearly dark.

Regaining the path we marched to Pidaung seeing one pig and hearing a *gyi* on the way.

Reached camp at Pidaung Station at 8 p.m., after an exceptionally interesting day.

* * * * *

REVIEWS.

ENGINEERING FOR FOREST RANGERS IN TROPICAL COUNTRIES WITH SPECIAL REFERENCE TO BURMA.

BY A. H. LLOYD, M.C., M.A., INDIAN FOREST SERVICE, LECTURER IN FOREST ENGINEERING, IMPERIAL FORESTRY INSTITUTE, OXFORD.

(The Clarendon Press, Oxford, 1929. 221 pages, 32 plates and 85 diagrams. Price 17s. 6d.)

This book is a welcome addition to the scanty literature on engineering as applied to forestry, a vast subject which includes every branch of engineering. • •

The author's difficulty has been in deciding what to include and what to exclude, so that it would be suitable in the first place as a text book for the Forest Ranger School in Burma. As an elementary text book it is excellent, and written in a very practical simple manner, so that those with a very small knowledge of engineering can understand.

The author has been an instructor at the Forest School in Burma, and we recognise many of his difficulties, which he has emphasised :—" Forest Rangers cannot be given a long course of training in the elementary principles of engineering hence it has frequently been found necessary in this manual to lay down rules dogmatically rather than to discuss the principles involved."

It has been taken for granted that a knowledge of " bricks and mortar" is not essential to the ranger in tropical countries. This will certainly limit the usefulness of the book, and it is unfortunate because in Northern India especially, the buildings are mostly 'pucca'. The subject is dismissed in five pages.

We agree that a ranger requires a good knowledge of road and bridge construction and this is treated in a very practical manner in a hundred pages—about half of the book.

The section on buildings deals entirely with timber structures, and will be useful in provinces like Bengal, where many of the buildings are of timber and resemble in many respects the Burma type.

Under exploitation, the section on the dragging of timber by elephants is brief, but good. The chapter on mechanical transport and light railways is too brief to be of any practical use. We agree with the author when he says—" Another important reason against the adoption of mechanical methods is that elephants and buffaloes are available. The maintaining of these animals is comparatively cheap, and they are particularly suited to the special conditions of timber extraction in the tropics. There are also other reasons such as the lack of skilled labour, and the shortage of roads, and forest railways suitable for the transport of heavy machinery, and it appears unlikely that

mechanical methods will replace the elephants and buffaloes in Burma and similar countries for many years." In most parts of India nothing has been found to equal good roads and country carts. There are only five pages on transport by water—a very important operation in Burma.

Water supply deals with the sinking of shallow wells. Other methods might have been mentioned *e.g.*, collecting chambers for springs—a very important source of supply, though perhaps not so important in Burma.

There is a useful miscellaneous chapter dealing with spars, tackle, blasting etc.

The book is beautifully illustrated with excellent photographs, and the drawings are clear.

This is a first effort and the author is to be congratulated. Standard text books have been consulted very freely and a great deal of information has been taken from Military Engineering ; the author served with the Royal Engineers during the war. The bibliography at the end of the book will be found useful to those who wish for more details.

We can recommend the book to newly joined assistants and to those who have had no practical experience of forest engineering in tropical countries like Burma.

C. T. T.

THE EVOLUTION AND CLASSIFICATION OF SOILS.

BY DR. E. RAMANN,

Principal of the Royal Bavarian Institute for Research in Forestry. Translated by Dr. C. L. Whittles, Late Director of the Experimental Station of the Sugar Planters' Association, British Guiana. Demy 8 vo. +118, cloth 7s. 6d. (W. Heffer and Sons Ltd., Cambridge, England).

This small volume presents in a concise form the evolution and classification of soils. The style and development are quite refreshing and should make an appeal to students interested in

fundamentals of soils. The author gives the basic principles of soil formation and rests the classification of soils on a climatic basis. The names of soils such as sand, clay, etc., are not basis for the classification of soils but rather aids for their description. In this volume an attempt has been made to show that the climate of the soil is the potent factor in the formation of soil and is responsible for the fact that even within the same climatic boundaries different soils are formed under different vegetative covering *e.g.*, forest and steppes.

The soils arise from the weathering of rocks and during this process certain salts are formed which are soluble in water. By the action of rain some of the soluble salts are removed by drainage and if the water is removed by evaporation the salt remain in the soil. The excess or deficiency of salts depends, therefore, on the relation between the rainfall and evaporation and thus principally on climatic conditions. All such places where the rainfall exceeds the amount evaporated from the soil, get rid of the surplus in the form of drainage water and consequently give rise to soils known as " humid soils." On the other hand, in places where the evaporation is high, so that considerably more water can be evaporated than is supplied to the soil by rain (practically no drainage water) are found the " arid soils." In between these two extremes fall the many type of soils of places having a periodic climate, which during one part of the year are subjected to humid conditions and during another part to arid conditions. In this manner distinction has been made between soils of the following climatic Zones.

1. Frigid—in which are found Tundra soils and forest shattered soils.
2. Temperate—having Northern sand Humus soils, Podsol, Forest Bleach earths and brown earths.
3. Sub-tropical—having yellow-earths.
4. Tropical—having Laterite, Red earths, Red loams, Tropical Brown earths, Tropical Bleached earths.

These zones and the more important soils found in them are described in second half of the book. The influences of local

factors are discussed in some detail. The descriptions are brief but they give the reader a clear impression of the connection between soil formation and climate and the processes by which the different types are evolved. The author includes information from several points of view including physics and chemistry. The subject which appears to be least developed is that of microbiology. The scope of the work is indicated by chapters on weathering, movement of soil water, soil organism, soil distribution, climatic soil zones, and general soil classification. In developing the subject the principal emphasis is placed upon the types of soils found in Central Europe and the classification of soils of sub-tropics and tropics has been neglected.

The translator's preface notes an endeavour to adhere as closely as possible to the German text though it is stated that some difficulty was encountered in finding suitable English equivalents for the names of soil types and some do not lend themselves to translation and have been retained in the original form. A useful bibliography is included to which the translator has added references to some of the more important papers that have appeared since the publication of the book in 1917.

S. K.

MANGROVE FORESTS OF THE MALAY PENINSULA.

"Mangrove Forests of the Malay Peninsula" by J. G. Watson, Deputy Conservator of Forests, Federated Malay States, is No. 6 of the Malayan Forest Records series. It is a most interesting and comprehensive publication, being more in the nature of an encyclopedia of general knowledge on Malayan mangrove forests, rather than an ordinary Forest Record. In the Introduction the author explains that the volume is compiled from the notes of various officers collected during the past 15 years and he modestly describes himself as the editor rather than the author of the book.

In the first chapter a most instructive account of the formation of mangrove forests is given. This is followed by descriptions of the fauna and flora and other general characteristics of the forests concerned. The forest flora especially is described

in great detail and is supplemented by a most useful key for the identification of the species concerned. This is followed by a chapter on the silviculture of Malayan tidal forests which comprises a most interesting description of the effects of inundation and the types of forests resulting therefrom. The management, exploitation and utilisation of the littoral forest of Malay also each have a chapter to themselves and there is a wealth of information in these chapters which is of the greatest interest to any one concerned with the management of tidal forests in the tropics.

The whole record is well printed and most liberally illustrated with no less than seventy-two excellent photographs, which make it the more attractive. In addition, there are sketch diagrams and maps illustrating important features, and giving the publication a value far surpassing that of the average descriptive booklet of a similar nature.

The publication can be obtained for three Malay dollars or seven English shillings from Messrs. Fraser and Neave, Ltd Singapore.

BIJDRAGE TOT DE KENNIS VAN PINUS MERKUSII JUNGH ET DE VR., MEER IN HET BIJZONDER IN DE GAJO LANDEN.

BY C. BRANDTS BUYS, C. JAPING EN D. FERNANDES.

MED. PROEFSTATION BOSCHWEZEN, NO. 19, 1928.

[Contribution to the knowledge of *Pinus Merkusii* with special reference to the Gajo country (N. W. Sumatra)].

This is a very useful monograph on a hitherto little known species of pine, which, if its authors are not unduly optimistic, may figure more prominently in the future. The language in which it is published makes perusal somewhat difficult for most Indian foresters, but much help is given by the 4 page German summary, the 50 quite passable photographs and the 18 graphs and 7 maps. Among the photographs No. 14, showing a very fine crop, No. 4 an open forest on recent volcanic soil, and Nos. 47—50 of resin channels may be signalised.

Summarising the German summary with due reference to he full text, we obtain the following information. *Pinus Merkusii* occurs in the Phillipines, Tonkin, Siam, Burma and Sumatra, and is unique as the only pine which occurs south of the equator, as it does in Sumatra. It occurs on all soils, and its range has been extended by denudation, burning, and shifting cultivation. Like *Pinus longifolia*, the fibres are often spirally twisted to the left in youth changing in old age to the right. Heights up to 230 ft. and diameters to 57″ were measured, and one of the finest crops examined had 46 trees per acre, crop height 164 ft. and diameter 24″ with a volume of 11,150 c.ft. per acre—but no age is quoted. The undergrowth is mostly of grasses of familiar genera, with bracken fern; of the shrubs, *Desmodium gyroides* and other species of *Desmodium* and *Flemingia* are the chief. The species regenerates very easily on mineral soil, so that grazing is helpful on steep ground but harmful on the flat where a close turf is formed. Similarly burning before regeneration is helpful, but afterwards wipes out the young plants; grass cutting is very helpful in the first year. Planting is also easy, provided the roots are not bent up (this is fatal), and heights up to 13′ are attained in 2 years' growth. Natural regeneration on poor soils however only grows to 8′ in 4 years. The species coppices like *Pinus longifolia*.

A long chapter IX is devoted to the resin industry, most of the investigations made being in this direction. Different tapping methods were compared as also the effect of depth of channel, freshening period, etc. The French method was found the best (as in India) with channel 5″ wide and $\frac{3}{4}$″ deep, taking the channels upwards $\frac{1}{6}$″ at each freshening, which extends over the upper 4″ only. The selected optimum period is 3 days, a good worker freshening 1000 channels in a day with a yield of 117 lbs.*, though this figure seems to be a maximum rather than an average.

Tapping is possible throughout the year with 120 freshenings. The best natural forest under continuous tapping with the

* There is an error in the figure 58 grams per freshening in the Summary on p. 138, as it is given as 53 grams = ·117 lb. on p. 97.

average yield of 0·1 lb. per channel per freshening is calculated to yield 1,340 lbs., (or say 17 maunds) per acre per year. The authors go on to demonstrate that pine plantations at this rate should be more paying than teak or rubber, the yields being far higher than in France or America. One of the photographs indicates a phenomenally rapid rate of occlusion of the channels.

The figures given may be compared with those for *Pinus longifolia* appearing in the 1927-28 Progress Report of the Resin Industry in Kumaon, United Provinces. 6-day freshenings are the rule. The average yield per channel for half this period would be ·07 lb. (0·14 maximum) but the number of channels rarely reaches the 112 per acre allowed in the Dutch calculation, averaging 21 only. From our yield tables, it may be seen that 112 would be possible only for fully stocked crops of large pole size and Quality Class I or II. It is thus seen that these estimates for Sumatra are very similar to our actuals for *Pinus longifolia*, and considering that the forests tapped are in 30°N latitude and many of them at 5-6000′ altitude, it is, if anything, surprising that the yield for *Pinus Merkusii* on the equator is not higher. The advantage of the latter lies, however, in the possibility of tapping for 12 months as against 7 or 8, and the apparently heavier stocking per acre.

Analysis of the turpentine and colophony show them as up to the best quality American and French products and hence the conclusion is reached that there is a rosy future for the resin tapping industry in Sumatra.

H. G. C.

EXTRACTS.

AGRICULTURE AND FORESTS.

(BY PROFESSOR E. P. STEBBING, F.L.S., F.R.G.S., ETC., LATE OF THE INDIAN FOREST SERVICE.)

The close connection existing between the forests and agricultural tracts of a country has received full recognition in

some parts of Western Europe. In these countries both rulers and ruled accept without question the necessity for a forest law and for the management of certain areas of forest on special lines in order that their perpetuation may be assured in the interests of the community and their successors as a whole; or of a section of that community dwelling in a specified region. That, in other words, the forests in question shall not be so burdened with rights or concessions, granted in the interest of the few, that their continuance is imperilled, if not threatened with total extinction. A widespread appreciation of this view-point has been slow and more specially has this been the case in the hotter regions of the globe. In many of these the doctrine is still called in question by both ruler and people alike. And yet if the following utterance by a French scientist is true for Europe, how much closer does it apply to the tropical and sub-tropical regions of the world. "On a tout dit" writes this French observer "sur l'utilité de la foret, bienfaisante à la terre et à l'humanité, gardienne de l'eau, réservoir inèpuisable de forces, par qui s'etablit l'équibre du climat et se reconstitute le sol nourricier ; c'est elle, les savants contemporains nous l'apprennent, qui restaure l'energie utile dans un monde qui va sans cesse s'usant et se degradant." Perhaps in no country in the world have these words a greater significance and hold a greater truth than in India. That the distribution of the forest in that country at the present time is not ideal, or even convenient for the bulk of the population, a glance at a forest map will render evident. And this distribution was strongly commented upon in the Report of the recent Royal Commission on Agriculture, issued in 1928; but the implied suggestion that the Forest Department was in any way responsible for this distribution suggests an absence of acquaintance with the main lines of the development and expansion of agriculture in India in early times.

As is well known the growth of modern India with its numerous races is a result of successive waves of invasion or immigration into the country from the north-west; both these latter had in the course of time a considerable influence on the forest. The Aryan invaders probably entered India some 2,000 year

B.C. They are considered to have been a pastoral and agricultural race and in the course of years must have been responsible for the clearance of a considerable area of forest in order to be able to carry on their pursuits. The axe and fire were probably the chief weapons made use of. There are in fact records, so far as they can be regarded as records (as against mere legend) in the ancient epics *Mahabharata* and *Ramayana*. In the first allusion is made to a great forest tract, situated between the Ganges and Jumna rivers, and known as the Khundava Forest. The destruction of this forest by fire furnishes the first semi-historical evidence of the methods employed to get rid of the extensive jungles in order to extend agricultural and grazing lands. Great difficulty, it is said, was experienced in burning this forest owing to the frequent rains which India poured down to quench the fire. In its recesses this great forest is said to have been dark and gloomy and dense, stretching up to and along the banks of the Jumna where barren and howling wastes now extend. Since the forest consisted of broad-leaved species in which there was probably a varying percentage of sal it would not burn easily in any single conflagration. But its ultimate fate under repeated burning, unchecked hacking and excess grazing, would not be in question and its disappearance a foregone conclusion. And this result is elsewhere foreshadowed in the epic, for in regions which the earlier settlers had cleared of forest drought and famines had already made their appearance—those twin scourges which were to periodically devastate the country during many succeeding centuries. In the *Ramayana* in the more densely cultivated and populated areas we find many allusions to drought. This epic dates from the time when an Aryan Empire was established in Oudh. With the re-occurrence of drought and famine, Sringa, the Forest-Born, is worshipped as the bringer of rain. Great forests stretching dark as a cloud in the wilderness of Taraka are mentioned here. Could these have been the forests of the Vindhyan and Satpura Hills? It is an interesting speculation as it would enable us to visualise, how far the forest had already been destroyed in the plains and the forest line forced back to the hilly regions in these early times—a point not without its

importance in the survey of Forests and Agriculture which is attempted here.

That the war waged against the forest was constant and persistent the evidence furnishes abundant proof. But the pioneers in this business had considerable difficulties to contend with, and not the least malaria and wild animals and the great vitality of many of the species forming the flora of the Indian jungles. In the long run the forests were doomed provided the attack was maintained with unflagging zeal and with increasing success as the resistance of the forest, as a forest, decreased. But the total disappearance of large forest areas would be a matter of centuries. They would not disappear with the rapidity which follows the firing of coniferous tracts as exemplified in the United States and Canada.

It appears probable that in early times India must have been covered with enormous stretches of dense impenetrable forests and that during the whole of the Brahmin and Buddhist periods forests still existed over large areas of the country adapted to their growth, the valleys and plains adjacent to the larger rivers being under an intensive cultivation. The great reduction of the forests was slowly brought about by the successive inflow of the Central Asian peoples bringing their flocks with them, tree growth being destroyed as both people and their flocks increased in numbers. The *Brahamanas*, which are ascribed by leading Sanskritists to the period 800-500 B.C. allude to the *Govikartri* or "Master of Forests" as one of the twelve important officers of State. Thus it appears that the forests, or portions of them, were already regarded as of sufficient importance to require an officer to look after them, even if this importance were only from a sporting point of view, which may have been a primary object.

At the time of the invasion of Alexander the Great (about 327 B.C.) the forests in the north of the Punjab were still said to be dense in spite of the fact that this was the part of the country where the Aryan invaders first developed a stable Government. It is not impossible that the Rulers of the time may have had practical proofs of the utility of forests and instituted some form

of conservation. In any event, records show that the Salt Range and the country on the banks of the Jhelum were clothed with forests dense enough to conceal the movements of Alexander's armies. Arrian, the historian, in describing the march east of the Jhelum wrote that the forests then extended over an almost boundless tract of country "shrouding it with umbrageous trees of stateliest growth and of extraordinary height; that the climate was salubrious, as the dense shade mitigated the violence of the heat, and that copious springs supplied the land with abundance of water." The region so described would appear to be the Pabbi and the low-lying country extending to the Chenab, in the southern parts of which scattered *Dalbergia Sissoo* and *Acacia arabica* are all that remain; for Arrian describes the high *ber* lands of the Punjab west of the Ravi as in much the same condition as they were some twenty-one centuries later when the English entered the Punjab.

After his death, one of Alexander's Generals founded the Syrian Monarchy and despatched an Ambassador, the Greek writer Megasthenes, to the Court of the great Indian Emperor of the times, Chandragupta (322 to 298 B.C.). Megasthenes mentions a great official, who may have been identical with the *Govikartri* of earlier times, who had charge of "the huntsmen who cleared the land of wild beasts and of fowls which devoured the seeds." However this may be the recently discovered treatise, the *Arthasastra* complied by Kautilya, the Brahman Minister of the Emperor, clearly shows that he brought into existence what was for those days an organised forest conservancy. As has been shown in a previous article in *India* he drew up a classification of various types of forest and instituted rules for their management with the most severe and drastic penalties for their infringement.

The destruction of the forests at an enhanced pace followed the Mohammedan invasion of India. The Mohammedan had no regard for the forests nor any religious scruples about destroying them. India suffered in this respect just as Persia, Asia Minor, Spain and other countries on the Mediterranean suffered. This invasion probably witnessed the final retirement of the old

indigenous population, constantly pressed backwards by the successive influx of new peoples from the north, into the fastnesses of the forest-covered hills where they practised that most wasteful and pernicious form of agriculture, called shifting cultivation. This method has been responsible, and is so still, for the destruction of much valuable forest in the world, a matter which will be referred to subsequently.

Although the Mogul Emperors cared little for the forests several of them evinced great interest in horticulture. The planting of trees, either for the fruit they yielded or for the purposes of obtaining a grateful shade, was a pious act which was held in high esteem in Eastern countries, and especially in India, from very early times. The banks of canals constructed by the Mohammedan Emperors, and the sides of the Imperial highways were planted with trees of various kinds. In a *Sanad* of the great Emperor Akbar it is directed "that on both sides of the canal down to Hissar, trees of every description, both for shade and blossom, be planted, so as to make it like the canal under the tree in Paradise; and that the sweet flavour of the rare fruits may reach the mouth of every one, and that from those luxuries a voice may go forth to travellers calling them to rest in the cities where their every want will be supplied."

That the wholesale destruction of forests in India has had a serious deteriorating effect on the climate and in some parts on agriculture itself is beyond cavil. The disappearance of the forests has often in the past been followed at varying intervals by man himself from the region affected. Historical proof of this contention is presented by numerous deserted sites of towns and villages, some represented by ruins of walls or mounds either buried in sand or overgrown by a dense jungle, which has once again reclothed the areas. Or clumps of old mango or tamarind trees, or other species commonly planted adjacent to villages, will be met by the forest officer or sportsman of the present day surrounded by and buried in the midst of a considerable forest tract, indicating the presence of old deserted village sites. The disappearance of the population from those sites is not always attributable to the clearance of all forest from the neighbouring

hills followed by the drying up of the sources of the water upon which the population were dependent. Extinction by invasion famine, disease or the depredations of wild animals have been reasons. But in too many cases the ignorance of the part played by the forest in its connection with water supplies upon which the crops and flocks of the agriculturist depended has been the sole cause for the disappearance of a few villages or a great tract of densely populated countryside.

(*India, June 1929.*)

INDIAN WOODS.

The important rooms in the vast building just erected by Imperial Chemicals, Limited, opposite the House of Lords are, in many instances, panelled with beautiful Indian woods. Lord Reading's room on the sixth floor has been executed in Indian laurel of exquisite beauty. This wood has rarely, if ever, been utilised previously in London. Rangoon teak has been freely used for staircases, dormer windows and electric fitments. This triumph for Indian woods follows on their utilisation for the great building of the International Labour Office at Geneva, and, earlier, their use for display purposes at the office of the India High Commissioner in Grosvenor Place. In the new India House in Aldwych they will be used almost exclusively. Their popularisation may mean much in the future to the financial success of the Indian Forest Department. Less than five per cent. of the structural woods used in this country are of Imperial origin and Indian resources are almost limitless.

(*Statesman*).

BIG GAME FROM CARS.

Sir,—The following are some of the points I should like to bring before your notice as regards the use of motors in connection with big-game hunting, particularly in that magnificent game country, the north-west of Tanganyika Territory. Nearly all shooting parties enter this country from Kenya with motor-lorries and probably a light touring car. And shooting parties go down

there generally for about five to six weeks' shoot, and come back with an average of five lions a gun (they are now limited to five), also buffalo, rhino, cheetah, and probably a leopard or two, and about 18 other different species of game.

They get a bag in a six weeks' shoot which in the old days, with porters, would take seven months or more shooting and working for it. The reason is that with cars distances are no object; if there is no game in their area, and it has moved on account of water, etc., say 100 miles, all that has to be done is to pack up the camp on to the lorries and in a few hours they are right out of that country and probably right up to the game.

I am sorry to say that a great deal of the game has been shot actually from cars. The best sportsmen do not use their cars to shoot from, but every one tours round the country looking for game in cars. All this really makes a farce of the whole thing and to my mind very little sport. There is practically no hunting required, and it only means that the so-called "big-game hunter" comes back at the end of six weeks with a fine bag obtained with practically no work, absolutely no hardships, and very little danger.

I have discussed this with many other hunters, and suggested using porters, and the answer is always the same, "You can't get porters"; but I maintain that this particular part of the country could be worked with porters, who could be obtained from the Mwanza and Ikoma district, where there are plenty of natives. Of course, the shooting parties would not get anything like the big bags, but in a couple of months' shooting they would get enough to satisfy any sportsman, and would have the satisfaction of knowing that they really had done some work to obtain these trophies. I should suggest that no shooting parties be allowed to take any lorries or cars beyond a Government station, and after that they must use porters. This in itself is a great advantage to the old days when one may have had to walk 200 to 300 miles or more before getting to the game country.

The refusal to allow lorries or cars to go beyond a Government station would be in itself a very great protection to the game, as the distances from some of the Government stations to

some of the best game countries are very great, and there is no native population to obtain *posho* for porters and boys; but this could to a great extent be overcome with proper organisation.

I do think that whatever game laws are made in regard to the use of motors in connexion with shooting, unless all lorries and cars are stopped from going beyond Government stations there will always be a way or means for some people to break the game laws. Unless this is done, or something similar, in my opinion the game in this particular magnificent game country in a few years' time will not be shot out but murdered out. I write this from the experience of over 20 years' shooting off and on in different parts of Africa, and in recent years as a professional hunter.

I am, etc.,

G. H. ANDERSON.

STONE COURT, SUNNINGDALE.

(*The Times.*)

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THE COWDUNG PROBLEM OR VILLAGE FORESTS.

I have read with much interest the note by Mr. Chaturvedi entitled "The Cowdung Problem—A Solution," published in the *Indian Forester* for May, 1929. The problem is one of extreme importance, especially in the United Provinces, where less than five per cent. of the total area is Government forest, and the greater part of that is situated in or on the fringes of the Himalayas, where export problems are of unusual difficulty. I once calculated, when in charge of a Himalayan Division, that the felling refuse from my deodar felling areas of one year alone would supply enough fuel to keep an ordinary English house going with a fire in every room all day and every day throughout the year for two hundred years! But transportation costs are so high that it is quite impossible to utilise the refuse as fuel, except in a few very favourably situated Divisions. Even in the plains Divisions, owing to the distribution problems fuel is only extracted from the most accessible areas, and that goes mainly to the large towns and not to the villages.

Mr. Chaturvedi's idea of solving the problem of fuel supply to the villagers and the consequent liberation of the cowdung for manure (except presumably such as will be required for spreading on kitchen floors, for mixing with mud for the plastering of walls and for maintaining such little fires as will be needed to keep up the supply of red-hot cowdung for putting in *huqqas* to make the old men's tobacco go a bit farther!) by the establishment of village forests is by no means a new idea. Village or communal

forests in other countries have proved highly successful, and I remember visiting one commune in Switzerland where a magnificent high school had been built out of the profits from the communal forests; but as a warning, it may be as well to mention that in another case not very far distant, the communal forests were a burden on the local tax-payers.

But whereas the communal forests one is acquainted with in other countries were for the greater part, if not entirely, in existence when the communes took them over, the village forests contemplated for the plains of the United Provinces are non-existent and have to be created. This again is not a new idea. It was contemplated as far back as 1873 by Sir Dietrich Brandis, and was laid down as the ultimate policy in the United Provinces Government resolution No. 348 of 1912. It was again contemplated by the Royal Commission on Agriculture in India, which suggested that certain areas now classified as "culturable waste" and "land not available for cultivation" might be added to the village forests to be managed by the *panchayats*, which implies that the Commission suggested that the villagers would themselves afforest such areas.

The new suggestion put forward by Mr. Chaturvedi is that the village forests could be raised as plantations on a *taungya* basis, the only stipulation being that Government should not assess the areas for revenue. Government would lose nothing, as it gets nothing from the areas as they are. The zamindar would get a plantation without cost. The cultivator would get land for cultivation rent free, in return for a little labour in raising the plantation. And subsequently the cultivator would get free fuel and fodder, while his crops would improve as a result of the cowdung manure now made available: the zamindar presumably would get a little reward in increased rents and from the sale of timber; while Government would be rewarded by the increased prosperity and happiness of the people, whose welfare is after all its main care. Utopia is attained! Good!

But stay! Is it all quite as easy as it sounds? Taking the assumptions and proposals as they stand, there is this little question of *taungya*. The *taungya* that forest officers are

most acquainted with is carried out for the artificial regeneration of clear felled forest areas. Here the soil is good and fine crops are assured to the cultivator. But this may not apply to village lands. Mr. Chaturvedi says—" there are always some lands near every village which are allowed to lie fallow owing to their being unfit for agricultural purposes." Now such land is to be planted up, and—" the cultivators will supply the labour for raising the village plantation in return for which they will get free land to cultivate between the rows of trees." Now will they do this? If the land is unfit for agricultural purposes, it is hardly to be expected that the villagers will come forth in large numbers for *taungya*, for the fact that they will get the land rent free will be set off by the condition that they will have to supply labour for the plantation. Further, these waste lands are usually trampled hard by cattle, and cultivation, even rent free, is not a very attractive proposition on such areas. The ordinary cultivator is not sufficiently far sighted to undertake an unattractive proposition for the prospect of a fuel supply in the dim future that he cannot properly realise. Further, the fuel supply is most needed and the cowdung problem is most urgent in the more densely populated parts of the plains. But because the areas are densely populated there is a great demand for culturable land. The "unculturable waste" is therefore usually really unculturable, and I cannot conceive that the villagers would be willing to tackle such waste land on a *taungya* system.

It may be argued that there are usually certain lands of somewhat better quality lying fallow. But these are not necessarily available for plantations, as they are required for intermittent cultivation. In some areas land is cultivated and left fallow alternately, owing to its incapacity, without constant manuring, to yield annual crops. To utilise these for the creation of plantations would be regarded by the cultivators as a hardship, for until the plantations are sufficiently old to yield fuel, the cultivator would still be unable to utilise his cowdung as manure to improve the productivity of his remaining fields. So to start off with, only areas not actually required even for intermittent cultivation could be used for the forest plantations.

So far as I am aware, the United Provinces Forest Department experiments at Budaun and Bijnor are not being carried out on a *taungya* basis, and I imagine that considerable difficulty would arise in trying to introduce *taungya* for the plantation of unculturable land in those districts. Cultivators were ready to raise plantations by *taungya* at Clutterbuckganj, but the land there is not strictly comparable with ordinary uncultivated land, as it would have been under cultivation had it not been a Government estate.

There are one or two other points to be considered. It is said that the cultivator gets his cowdung free, so he will want wood fuel free, and Mr. Chaturvedi suggests that he will get it free. But a few lines later he implies that the cultivator may have to buy the fuel—the cultivator " would soon wake up to the fact that his cowdung as manure brings him more money in the shape of increased yield from his field, than what he saves in fuel if he burns it. He would sooner buy his fuel than burn his valuable manure." I do not suggest that Mr. Chaturvedi first turns to the cultivator and says—" you do the *taungya* and we will give you free fuel in the future," and then turns to the zamindar with a knowing look and says—" once the cultivators get a little free fuel, make them use their manure on their fields, and when they have realised its value, you will be able to charge them for future fuel supplies." But I would emphasise that unless some very clear and definite arrangement is made from the start and is rigidly adhered to as a legal matter, discontent and trouble are sure to result.

Another point is the question of statistics. One wishes that Mr. Chaturvedi had provided a few figures; even rough figures based on work in the Afforestation Division would have been better than nothing. If Mr. Chaturvedi has been advising the zamindars who have been making numerous enquiries, he presumably has got statistics of some sort. One would like to know what are the chief species to be planted, what are the rotations suggested and what sizes it is expected to obtain in these rotations, and what are the estimated yields per acre, as thinnings and as final crop. Further,

since he calls his scheme a "solution" to the cowdung problem, one would like to know whether he considers village forests can be established to supply the whole demand of the population, and if so, what is his rough estimate of the fuel consumption per head of population per year, and what area would be required for a village or group of villages of given population.

So much for the details of the scheme. Let us now consider the general principles underlying it. Mr. Chaturvedi proposes to solve the cowdung problem by the creation of village forests. Now this involves two main assumptions :—

(*a*) that there are sufficient areas in the plains available for the creation of village forests of sufficient extent to satisfy the fuel requirements of the villages ;

(*b*) that assuming (a) is correct, then when the fuel supply is established, the cowdung will all be available for manure.

Considering (b) first, a very important point is missed. This is that a large amount of cowdung is not used as fuel by the villagers themselves, but is taken to and sold in large towns. So the cowdung problem does not resolve itself simply to the problem of supplying fuel to the villagers, but also includes the problem of supplying fuel to the towns. And the fuel supply to the towns must be able to compete in price with the cowdung fuel, for the townsmen will buy the cheapest fuel and the villagers will bring their cowdung into the towns so long as they can keep their rates lower than those prevailing for wood fuel. The critical rate naturally varies according to the distance of supplies and other local factors, and a table could be prepared for any given town showing the distances from which it would pay to import cowdung corresponding to various rates for wood fuel. On the average perhaps about 7 annas a maund is the critical rate at or below which the townsmen would prefer wood to cowdung, and at or below which it would not pay the villagers to take their cowdung to the towns.

The Royal Commission on Agriculture suggested that fuel from the existing forests might be made more available by the co-operation of the Forest Department and the railway authorities

to secure the reduction of railway freight rates and the establishment of fuel depôts. Some such co-operation might possibly affect the fuel supply to large towns and a few agricultural districts, but it could not do much. The cost of carriage to the railways from the forests is an important factor, which necessarily restricts the areas from which fuel can be profitably exported. Also, owing to the small extent of the forests in the United Provinces, the full fuel demand could never be supplied.

The solution of the cowdung problem therefore lies in the creation of forests in the plains, to such an extent as will not only satisfy the requirements of the rural population, but will also provide to the towns the large quantities of fuel that are required to augment the supplies obtainable from the existing forests. The need for afforestation in the plains has long been realised in the United Provinces. A general policy with this ideal was laid down in 1912 and has since been confirmed on more than one occasion. The existing Afforestation Division is the result of this policy, and Government has shown itself by no means ungenerous in voting the expenditure (which now amounts to well over a lakh of rupees a year) necessary for the experiments and large scale work carried on.

The Royal Commission on Agriculture contemplated the handing over of wooded areas under the Forest Department to village *panchayats*, where such areas were interspersed among cultivation and were eminently suitable for village forests. In the United Provinces this is impossible, as there are practically no such lands held by the Forest Department. But the Commission also contemplated the creation of forests on suitable unculturable waste land. They realised that if this were carried out to the extent required, it would have to be done by a special staff, and therefore proposed that the Forest Department should be divided into two divisions. Far from being a "pious hope," the proposal is, I consider, essentially sound. To my mind, the whole question of the creation of forests throughout the plains is of such vital importance and of such extensive possibilities that the work hitherto carried out can only be regarded as touching the outermost fringe of the subject. Much as I admire the work

being carried on by the United Provinces Forest Department in afforesting plains areas, I feel that this type of work is a specialised work, which if it is to be extended to the extent required calls for a specialised executive and administrative staff, consisting of forest officers who have had training also in agriculture, particularly concerning soils and their ecology and general rural economy, but also including a detailed study of grasses, since grazing problems arise simultaneously with the creation of forests.

This brings us to the first great assumption in Mr. Chaturvedi's scheme, namely that there are sufficient areas in the plains available for the creation of village forests. It is impossible to say that there are or are not sufficient areas available, although on the face of it one is tempted definitely to assert that in the densely populated areas, where the demand for fuel is greatest but where also the cultivation is the most intense, there is certainly not enough land available for forest plantations, or even that there is no land at all available. A detailed examination of the waste lands is obviously needed to determine how much is available for forests. A "systematic survey of the available area" was suggested in the Government resolution of 1912, and the necessity was again pointed out by the Royal Commission, which expressed dissatisfaction with the ordinary classification of waste land into culturable and unculturable. Far from being a "pious hope", this is again a practical suggestion, and it is the first duty that the specialised agri-forest staff would have to tackle.

The exact lines of re-classification would have to be subject to considerable modifications and re-modifications, according as experience showed them to be necessary, and the preliminary work would probably need close co-operation between the agri-forest specialist staff and the Revenue Department. For a start I venture to suggest some such classification as follows :—

I. Absolutely waste. Areas such as pure sand river beds, deserts, bare rock, etc. ... ... (1)

II. Unfit for forest, but suitable for grazing. Areas liable to flooding or water-logging, and other

areas which provide grass for the whole or part of the year, but which are unsuitable either for agriculture or for fuel plantations ... ... (2)

III. Unfit for cultivation, but fit for forest.

(*a*) Required solely for grazing, the incidence of which prohibits the establishment of plantations (3)

(*b*) Not required solely for grazing, and in which plantations could be created.

(*i*) Small areas in the vicinity of villages or towns (4)

(*ii*) Large areas in the vicinity of villages or towns (5)

(*iii*) Large areas not in the vicinity of villages or towns ... ... (6)

IV. Fit for cultivation.

A. At present not required at all for cultivation.

(*a*) Required solely for grazing, the incidence of which prohibits the establishment of plantations (7)

(*b*) Not required solely for grazing, and in which plantations could be created.

(*i*) Small areas in the vicinity of villages and towns (8)

(*ii*) Large areas not in the vicinity of villages and towns ... ... (9)

B. Required for intermittent cultivation ... ... (10)

The areas with which our agri-forest specialists would be primarily concerned are divisible into two main groups :—

(i) Areas suitable for village forests. Types 4 and 8, and also small portions of type 5, if areas of types 4 and 8 were not available in sufficient quantities.

(ii) Areas not suitable for village forests, but in which more extensive forests could be established as financial propositions, mainly for the supply of fuel to large towns, or to agricultural areas where the population is dense and there is insufficient land for the creation of local village forests. Type 5.

Areas of types 1, 2 and 10 would not concern our agri-foresters at all, while areas of types 3 and 7 would either not

concern them, or alternatively might come under consideration if the agri-foresters also took up the questions of grazing improvement and fodder supplies in purely grazing areas. Areas of types 6 and 9 would not be of immediate importance, being away from centres of consumption, but as a matter of national importance a far sighted Government might take up the question of afforestation of large areas away from villages or towns for the purposes of timber production, protection of the soil and prevention of erosion, or for other reasons.

A classification of the type indicated would not be an easy task, but I believe it to be possible, and it would, of course, be of enormous value. At first it would be carried out only in selected districts, but as time went on it would eventually cover the whole of the waste land in the Provinces. In the areas selected first, experimental and demonstration plantations would be raised at Government expense in the manner now being carried out by the United Provinces Forest Department, with the express object of interesting village communities and zamindars in the projects, and also of collecting further silvicultural knowledge and statistics. From these statistics and from the area figures obtained as a result of the reclassification of the waste lands, together with a knowledge of the local distribution of population and the local fuel and timber requirements, it would be possible to elaborate an extensive scheme for the creation of the plains forests, commencing with the areas where work would be easiest and where the plantations are most urgently needed. The specialist staff would then advise or act accordingly to bring the scheme to fruition.

For the reasons already given, I doubt whether *taungya* is going to solve the question of cost, except possibly in exceptional conditions. It will be necessary for Government to assist financially, in the case of the smaller plantations by grants, especially for village forests, and in the case of large areas by loans at favourable rates, while for certain selected areas, the existing scheme of entire Government management on a profit sharing basis could be continued. As suggested by Mr. Chaturvedi, all land on which forest plantations are established

should be free from assessment for land revenue. In the case of small areas, established solely for the requirements of villagers, exemption from assessment might well be permanent (or at a very low nominal fee, liable to revision at long intervals, to satisfy the opponents to permanent settlements). In the case of larger areas, where it was found after a fixed number of years that the forests established were being managed as financial concerns, then assessment for land revenue should be made, although at a very much lower rate than for agricultural land.

A further method in which Government could assist, without much trouble, could be in the provision of free seed for *bona fide* plantation works, or even in the provision of free cuttings from large central nurseries. I was amazed last year when studying certain municipal forests to find how expensive it was for the municipality to purchase seed from Government forests for plantation works.

A point that arises in connection with the village forests is that of ownership. The Royal Commission on Agriculture in India apparently contemplated communal forests, which were to be estabilshed by the handing over to village *panchayats* of wooded areas interspersed among cultivation and suitable waste areas at present held by the Forest Department. Communal forests were also apparently contemplated in the Government resolution of 1912, in which mention was made of "a future in which enlightened local bodies should undertake the establishment of such plantations and from them derive and diffuse much benefit." But in the United Provinces there is one great difficulty to be faced, which is that all land in the plains is already under private ownership. There are no unclassed or protected forests under Government ownership which could be handed over to village *panchayats*, and the land owners are extremely reluctant to part with even waste land. Any act or bill having as its object the acquisition of private land for communal forests would be certain of a most stormy passage through the Council.

The question of the advantages of either private or communal ownership is an important matter of social economy, which it is impossible for me to attempt to discuss here, even if I were

qualified to do so. But it is certainly worth considering whether, in view of the modern tendency to revert to communal ownership and control of matters of communal importance, it would not be a more far sighted policy to encourage the establishment of truly communal forests. If this policy be adopted, then even without an acquisition act, it might be possible to encourage broad minded land owners to give or sell certain waste lands to local bodies for the creation of communal forests, and in the long run the increased prosperity of the villagers might well repay the landlord for the sacrifice of his ownership of the communal forest area. This of course only concerns the lands in the vicinity of villages and towns. The efforts of the United Provinces Forest Department, through the Afforestation Division, to interest large land owners in the afforestation of extensive waste lands is a move entirely in the right direction.

One of the first objections that will be raised to any such scheme as I have outlined for the establishment of a specialist agri-forest staff, and for the carrying out of the reclassification of waste lands and the inauguration of all the plantation work needed, will be that of expense. And if loans or grants are to be given to private or communal owners, the total cost may well give cause for hesitation. Further, it may be found that local villagers or zamindars are not everywhere prepared to constitute plantations on their own account, in which case, if the policy be that village forests will be constituted by Government in such circumstances, then there will be the capital expenditure on these forests, which even when they begin to yield revenue may quite possibly not give a very high rate of interest.

Fortunately the United Provinces Government have definitely adopted an afforestation policy and, judging from the past allotments for the Afforestation Division, it is to be hoped that the extra expenditure needed for a scheme such as I have outlined would be generously voted. To all financial objections, I would contend that this provision of fuel for the villages and towns in order that cowdung may be released for manure is a matter of great importance for the general welfare of the people. Expenditure on this work must be regarded as on a level with

expenditure on education:—not intended necessarily to bring concrete financial revenue to Government, but calculated to increase the general happiness and prosperity of the people. Accountants-in-chief should no more worry about compound interest on expenditure for village plantations than they do about compound interest for village education. Further, whereas education is a continually recurring and increasing charge, the expenditure for village plantations would not be indefinitely recurring, for as the plantations became established all over the country, their importance in village economy would be fully realised and their maintenance would be one of the first cares of the enlightened agriculturist. Politicians are anxious to show that they have the real interests of their fellow Indians at heart and are thus qualified for self government. Government should be of the people, for the people. Nothing could be more in the interests of such a predominantly agricultural people than the creation of village forests. Now, therefore, is the time for action!

NAINI TAL,
July 1st 1929.

E. C. MOBBS, I.F.S.,
Deputy Conservator of Forests,
United Provinces.

THE REGENERATION OF TROPICAL EVERGREEN FORESTS (RAIN FOREST.)

BY H. G. CHAMPION, SILVICULTURIST.

(Continued from pages 429—46 August number.)

II. IMPROVEMENT WORKS FOR NATURAL REGENERATION.

In considering the attempts which have been made to maintain or increase the proportion of the more valuable species in these forests, it is most convenient to deal with several areas separately.

(*i*) *The West Coast—Bombay.*—Attention at present seems to be concentrated on the mixed deciduous forests with teak, and working plans have little to say about the evergreen forests.

Coorg.—The forests near Makut were brought under Working Plan by Mr. Tireman[15] in 1916 and this appears to be

the first Indian Working Plan dealing primarily with evergreen forest. Selection fellings on a diameter limit were prescribed leaving seed trees as required and also one-third of the total number of exploitable trees; improvement fellings favouring the better species were to be made over 1,200 acres annually, and were to be followed by cleanings to be done as found necessary, but estimated to be needed annually for the first three years and then triennially. Though the area figures have not been worked up to for various reasons, quite enough has been done to show that promising results are possible. Thus in the Urti coupe of 100 acres, felled in 1921-22 and cleaned in 1925 with the removal of all the overwood except 5-10 seed trees per acre, saplings of *Hopea* and *Vateria* are abundant and can be expected to look after themselves with at most one more cleaning; round some of the old trees, the *Hopea* regeneration is magnificent.

A series of experimental plots was laid down in 1919 (by Mr. Ayyar) to follow the effects of varying manipulation of the upper and middle canopies; a heavy opening of the upper canopy with cleanings, as just described, was found to be the most satisfactory procedure, *Mesua*, *Calophyllum*, *Dipterocarpus* and *Hopea* seedlings having grown to 10 feet to 12 feet by 1926.

Mangalore.—Jalsur East, apparently a transition from the typical evergreen type to mixed deciduous with *Hopea* well represented, is one of the finest results of work of the kind obtained hitherto. Fellings began in 1916, small *Hopea* regeneration being present. In the course of the next few years the rest of the overcrop was removed, much by girdling. Frequent cleanings and weedings (which are said to have cost Rs. 12-9-8 per acre up to 1927) have been done to keep down the evergreen shrub growth which tends to outgrow the *Hopea*. *Hopea* saplings are now found all over the area with a height of 4 feet to 15 feet, rarely 20 feet, forming virtually an even-aged pure crop.

Chenat Nair.—The effect of cutting the undergrowth up to various heights, and of soil working before felling were brought under systematic observations in 1921 (Experimental Plots 20—24). The development of pre-existing regeneration in the logged areas of 1923 is also being watched with cleanings as

necessary : so far, it would appear that locally a fair proportion of useful species will grow up, but the best species will be poorly represented, and parts will be completely changed in character for a generation or more. Small regeneration was plentiful enough originally. It is found that seedlings should not be suddenly exposed by over heavy weedings. One hundred individual seedlings of *Dichopsis*, *Calophyllum*, *Mesua*, *Cullenia* are under observation since 1921 (Experimental Plot 26). A recent report is not available, but after 3 seasons results were rather inconclusive. Cutting the low shrubs only made little difference in the mortality or growth, and *Calophyllum* is definitely helped by lightening the upper canopy layers.

Mt. Stuart.—(Karian Shola).—A fine block of almost 3,000 acres of virtually unworked forest with fine *Hopea*, *Mesua*, etc. Cleanings have been done at about Rs. 3 per acre to help the existing small regeneration of these species which appear somewhat slow to respond when the upper canopy remains intact. Experimental plots have been laid down to follow the effect of varying manipulation of the canopy and weedings, but at present they appear a mass of *Strobilanthus*.

Tinnevelly (*Papanasam*).—For over 20 years now,[25] cleanings have been done to help *Hopea* and *Balanocarpus*, mainly by girdling inferior species and hollow mother trees over the abundant regeneration ; the results are promising on the whole and groups of good young poles, so unusual a sight in the tropical rain forest, are frequently encountered.

Travancore.—No accounts of work in Travancore have been traced, if any exist.

(ii) *Eastern Himalaya.*—Very little is on record with regard to the limited evergreen forests of Northern Bengal, Assam and the foothills. The *taungya* system is so well established and successful in the mixed deciduous forest that natural regeneration of the relatively scattered patches of evergreen as a special problem is unlikely to be attempted for some time, though small areas of this and much of the "wet mixed type" are included in the yearly coupes.

(iii) *Southern Assam.*—As far as is known to the writer, systematic operations to favour regeneration have not hitherto been made, but useful information has been collected for over a score of species on natural regeneration round mother trees with some help from cleanings, demonstrating that such work can give very useful results. It is understood that the working plans under compilation for Cachar[23] and the Upper Brahmaputra forests will prescribe such work.

(iv) *Chittagong and Arakan.*—In *Chittagong*, the evergreen forests, as we have seen, are much mixed with the "wet mixed" and '*garjan*' (*Dipterocarpus* spp.) forests. Very little virgin forest is left, and most of the area one would expect to carry rain forest had been jhumed at one time or another. The pure *garjan* may also be largely a secondary type. Under the Working Plans, natural regeneration (which is plentiful) will be relied on for the *garjan* whilst the *taungya* method is being established for the other types. Cultural operations do not appear to have been tried at least on any appreciable scale.

Arakan.—Very little appears to have been done hitherto beyond local attempts to free teak regeneration originating from older plantations.

(v) *Burma and Upper Assam.*—*Burma* appears to have found that there was more than enough to do in the mixed deciduous forests which contain the valuable teak and useful species such as *pyingado*, and relatively little work of the kind under consideration has been done in the tropical evergreen. In Katha Division (Auktaw, R. F.) some experiments on getting up the abundant *kanyin* (*Dipterocarpus turbinatus*) by manipulation of the canopy and weeding have been tried, and show that development though satisfactory, cannot be expected to be very rapid[24]: this forest is again hardly typical. Some work is also in progress in Petsut R. F., and experimental plots have been laid out.

Upper Assam has hardly touched the problem yet[26], all attempts having been with artificial regeneration—few of them in tropical rain forest, and those mainly on old jhumed areas, or forests more or less altered by heavy working in the past.

(vi) *Andamans.*—The North Andamans was brought under a Working Plan by Todd in 1906, and a revision was made in 1915 for about half the total area. Conditions render the selection system the only possible one, and the clear fellings which have been comtemplated are wisely considered dangerous. It is noted in the 1925-26 Annual Report, that no cultural operations are at present practicable; no regeneration operations were undertaken, the fellings being confined to the removal of the mature and overmature stock.

12. ARTIFICIAL REGENERATION.

This subject is also best dealt with by localities, but it may be noted that it is not easy in many cases to make sure from the records that the original forest was of the true tropical evergreen type, and many successully stocked areas stated to belong here were probably really wet mixed forest, whilst yet others may have been the real thing originally, but were taken up after ancient jhuming had appreciably altered their character. These remarks must be borne in mind in evaluating the following notes.

(i) *West Coast.—Bombay.*—Judging from the recent Annual Reports, no plantation work has been done in typical rain forest areas.

Coorg.—Although plantations of teak and bamboo have been made at Makut, the sites selected are outside the evergreen area, and the soil is totally unsuitable for teak. The plantations round Mercara are above the limits of altitude under consideration.

Mangalore.—At Jalsur, *Hopea* has been sown (in 1921) in patches spaced $12' \times 12'$ under the evergreen forest after light fellings and removal of all the lower canopy up to $25'$ high. The plants are only $2'-5'$ high, but persist in fair number. It is questionable whether results will be obtained in any way comparable to the excellent natural regeneration already referred to.

Chenat Nair.—Experiments were begun in 1921 to devise a practical method of getting up regeneration before the fellings, when it does not already exist on the ground. Sowings and

plantings of *Hopea*, *Artocarpus*, *Mangifera* and *Dichopsis* were made in half-acre plots with four variations of canopy manipulation and an untouched control. The best results were obtained when the lower stages were removed, plants surviving in about 25 per cent. of patches and being 1′—3′ high after 3 seasons. Further trials were made in 1924 with sowings of *Mesua* and *Calophyllum*, the former being a failure and the latter giving 50—60 per cent. survival after 2 years, though the plants were still small and slender; the lowest tree canopy (to 20 ft.) was removed at the beginning of operations.

Tinnevelly.—The cultural operations described above have been liberally supplemented by sowings and plantings costing about Rs. 15 per acre with the usual removal of small trees (all below 2′ girth as a rule). Various species have been used; *Balanocarpus*, *Gluta*, *Hardwickia pinnata*, *Mesua*, *Pygeum*, *Vitex*, *Chickrassia*, *Acrocarpus*, etc., though *Hopea* has usually been preferred. In the 1921 area at least, there are a lot of promising plants resulting, but they have yet to be finally freed. It is rather a feature here that the work done has been very scattered, favourable spots likely to give success having advisedly been chosen for such initial experiments. Dealing with an extensive compact coupe would involve further problems not yet tackled.

(ii) *Eastern Himalayas.*—The patches of evergreen forest are commonly included with the wet-mixed and sal forests for working purposes in the several Working Plans in force, the idea being to regenerate them by *taungya* methods. There is little doubt but that provided a good burn is obtained and the ground is not too wet, sal can be extended beyond its present limits, just as the evergreen types are tending with fire protection to extend over the existing sal areas. Some parts, however, probably including much of the type we are interested in, are unsuited to sal and different species are being or will be used, the chief being *Lagerstroemia Flos-Reginae*, whilst *Bischofia* is put in the badly drained hollows.

(iii) *Chittagong and Arakan.*—Plantation work has been going on since the seventies along the Chittagong River and some parts at least may well have been originally under evergreen

forest, though they had been jhumed before and bamboos had occupied much of the ground, facilitating a clean burn. In the recent *taungyas*, almost all on ground with heavy bamboo growth and therefore *not* primary evergreen, only one year's cultivation is customary, and weedings have to be continued to the 5th year, the weed growth being very heavy. *Bischofia* gives a complete cover 12′ high in three seasons, and *Lagerstroemia Flos-Reginae* has done 45′ high and 4″ diameter in 8 years, whilst of the slower growing species, *Dipterocarpus turbinatus* has reached three feet in two seasons. *Mesua* of 1881 has proved slow being only 6″ diameter after 45 years, but it is overcrowded; *Swietenia macrophylla* of approximately the same age is 80′ high and up to 18″ diameter. *Taungyas* started in 1923 near Harbang are not too good, but show that the *Dipterocarpus* should offer no special difficulty, (4′—7′/6′ in 4 seasons). No work has been done in virgin forest. Little information appears to have been published on work in Arakan[9], but some degree of success has been obtained with teak *taungya* on evergreen soils.

(iv) *Southern Assam.*—Plantation work has been under trial in Cachar since 1918 when *Mesua* line sowings were made, as well as sowings of *Lophopetalum, Bischofia, Aquilaria,* etc., (the plants are up to 30′ high after 8 years). Clearfelling, burning and broadcasting seed was tried in 1922-23: the plants are now 10′ high or so, but irregularly distributed and in danger of being smothered. *Gmelina, Cedrela, Artocarpus,* etc., have been sown in patches or transplanted with 6′ × 6′ spacing or along contour lines. Constant weeding has been practised and has resulted in a change to grass which is doubtfully desirable. *Taungyas* since 1922 with teak, at first spaced 30′ × 10′ (now 18′ high), but now down to 30′ × 6′, have been fairly successful, and patch sowings of *Dipterocarpus turbinatus* have done well. In Sylhet, extensive plantations have been made since 1922 on old jhumed areas where the bamboo gives a good burn. Teak and *Gmelina* have been used almost exclusively, and have done well—formerly mixtures of the two species were used, but this is now here as elsewhere abandoned in favour of pure crops of extent varying with the soil.

(v) *Burma.*—As we have seen, *taungya* and plantation work have tended to avoid the real evergreen areas, and the local occurrences in moist hollows, etc., when included have not as a rule been very successful, owing probably to a combination of a less satisfactory burn, less suitable soil conditions for the species sown, and extra heavy weed growth.

In South Tenasserim (Smith[4] loc. cit. p. 22), planting operations have been in progress since 1889, more or less continually up to 1923, but only 56 acres are considered worthy to be called plantations. These are all teak, other species having given no results—probably largely owing to bad work. The teak is obviously not at home and *pyingado* not much better. A new start is to be made with *Pterocarpus dalbergioides, Lagerstroemia Flos-Reginae,* and *Lagerstroemia hypoleuca,* while experiments with local species are in progress. The bamboo areas will first be tackled, the sub-evergreen tangle appearing too difficult a problem to be dealt with at present. It is not proposed to do planting work in the 'giant evergreen' forests, in any case.

Upper Assam has done work in Sadiya and Lakhimpur Divisions, apart from the plantations in the old jhums at Bogopani In Jokai, mixed line sowings 33′ apart and 4′ to 12′ wide have been tried using *Morus, Artocarpus, Lagerstroemia Flos-Reginae,* etc., and especially *Terminalia myriocarpa,* this type of work having been started in 1921 by Cooper in Nowgong. It cannot be said that success in Jokai has been definitely obtained; weed-growth is terrific, and if the early promise is to be maintained, the weeding will have to be very carefully watched and will be costly. It may be noted that on account of the *Mesua* regeneration which it is desired to retain, burning is not feasible. A small *taungya* of 1923 planted at 20′ × 4′ with *Cedrela, Morus* and *Terminalia myriocarpa* looks more promising, cattle having helped to keep the weeds in check.

Some interesting work has been in progress since 1923 at Murkong Sillik. After the timber has been logged, 8′ lines are cleared through the debris which is stacked between the lines and burnt as thoroughly as possible. Mixed sowings of *Terminalia*

myriocarpa, *Lagerstroemia Flos-Reginae*, *Bischofia* and *Cedrela* are made at stakes 10′ apart along the lines, *Morus laevigata* being added later. Costs were Rs. 21 the first year, but have been reduced to Rs. 13 or so since. The 3-year-old plants are up to 15′ high and can hold their own against grass, but the weeds have not been effectively disposed of and climbers threaten to become dangerous. Work in the Sadiya Fuel area is generally similar, but it has cost a great deal. Constant weeding has been done by the Forest Guards, and many of the trees are above the 12′—20′ grass. Quick growing species such as *Duabanga*, *Kydia* and *Cedrela* have done best, but there is some good *Terminalia myriocarpa*. Here again old jhumed areas with a secondary type of vegetation are in question.

(vi) *Andamans* [21].—Some teak plantations were made as long ago as 1886-90, and there is a considerable area planted to *padauk*, which is the species chiefly grown, dating back to 1903. Details are not available, but it appears that a good deal of the area may not have been typical tropical evergreen. *Albizzia moluccana* is grown for fuel and shows a phenomenal increment, 6′ trees in 10 years (*loc. cit.* p. 4.)

13. Work in other Countries.

A search has been made for literature describing natural or artificial regeneration work in the tropical evergreen forests of other countries, notably the Federated Malay States,* the Philippine Islands, Java, West Africa, and Central and Southern America, but virtually nothing has been traced, and it would appear that forestry has advanced no further with them than with us, and for much the same reasons.

14. Summary of Present Knowledge.

Owing mainly to the special natural difficulties of the problem, to the greater economic importance of the mixed deciduous forests, and to the outstanding position of teak timber in nearly all the areas concerned, but very little progress has hitherto been made in our knowledge of the regeneration of Indian tropical

* A very interesting account of the evergreen forests of Malaya has since been published by Mr. H. R. Blanford, *vide Indian Forester*, June and July 1929.

evergreen forests whether by natural or by artificial means. With the development of markets for the mixed timber from these forests, the question is becoming one of considerable importance, and in view of its unquestioned difficulty, requires to be taken up *before* the forests are submitted to heavy fellings.

It is quite clear that after heavy fellings *not* followed up by cultural operations, regrowth is not satisfactory; at best, the more valuable species on which the fellings are concentrated do not recover their former proportion of the ground, and more usually quick growing inferior and usually deciduous species or bamboo and cane gain the upper hand. Although some indications of a progression back to the original evergreen type can often be discerned, it is unquestionably an extremely slow process, and to rely on it can never be sound forestry. After opening up of the canopy, the equilibrium shews a pronounced tendency to shift more or less toward the next drier type, the moist mixed forest, and it is extremely probable that historically, the tropical evergreen type as a climatic climax has been slowly invasive on territory not originally possessing suitable conditions for it. It should therefore be possible to restock *some* of the ground after clearing or heavy felling with the more valuable species of the moist mixed forest, *i.e.*, teak, *pyingado* and *padauk*, but these species, particularly the first, will not thrive in typical evergreen areas. A strong burn will favour this retrogression from evergreen as also will repeated jhuming, the common consequence of which is a drying out of the soil and development of bamboo growth.

Many evergreen forests contain plenty of small regeneration which if not too suddenly uncovered and if given aid for a few years against competing weeds, is capable of developing into a regrowth better than the original forest. In dealing with extensive areas, however, it will certainly be very irregular and will fall much short of what is expected of modern forestry operations, and for some forests may fail altogether from want of regeneration at the start or for other reasons.

Attempts at artificial regeneration in this type have met with very partial success, and that mostly in non-typical areas, usually areas which have been jhumed over formerly. The

indications are that where conditions are limiting for the evergreen type, standard *taungya* or plantation methods will give satisfactory results, but under typical evergreen conditions, the original species must be used and weeding will be prolonged and costly; weeding can however be done to excess, as an unfavourable mat of grass roots may result, and most evergreen species seem to be helped by some shade at first.

Experiments aiming at the supplementing of natural regeneration by sowings and plantings have not been extensive enough to do more than indicate that there are reasonable prospects of results justifying the expenditure.

15. PROPOSALS FOR FUTURE WORK.

(i) *Fellings.*—In view of our ignorance of the subject and the known marked deterioration of felled-over evergreen forests where regeneration has *not* been obtained, fellings should be held in abeyance as far as possible for a decade, and adequate research undertaken to provide an answer in that time. Where fellings must continue, they should as far as is practicable be of a light selection type breaking the canopy no more than is unavoidable. Where a method of regeneration has been found (as at Makut in Coorg) fellings can continue over such area annually as can be covered by the necessary cultural operations.

(ii) *Research.*—Where the evergreen problem is pressing as in Assam, South Burma and Madras, a special officer should be detailed without delay for initiating and putting through investigations on an adequate scale: the problem is a difficult one and calls for a man on the spot most of the year, continuously or at frequent intervals. Experiments should be located in as accessible a spot as possible, offering typical conditions as regards type of forest, climate, etc., but otherwise offering the most promising opportunity as regards labour, etc.,—the purely silvicultural problems have to be solved first.

(iii) *Silvicultural System.*—It would seem natural that the true selection system (not the mis-called Indian variety) should be applied to these evergreen forests, but conditions in most of them are such that concentrated extraction is almost a *sine quâ*

non of the exploitation of the stocks of overmature timber of mixed species which they contain. Even where the so-called selection system is applied and fellings are limited to trees of fairly high diameter, the first cycle usually falls rather drastically on the forest and greatly alters it. Admitting heavy fellings as unavoidable, the alternatives are :—

(*a*) Clearfelling depending on the natural re-growth for regeneration.

(*b*) Clearfelling depending on artificial regeneration with or without field crops.

(*c*) Retention of some sort of shelterwood for a shorter or longer period, with or without seed bearers, to allow of the establishment of a new crop from natural regeneration or artificial regeneration, or both combined.

(*d*) Preliminary operations prior to the commercial fellings, aiming at getting enough regeneration on the ground by natural and artificial means before uncovering.

Which of these alternatives is preferable will depend on local conditions, and on the results of investigations which have for the most part still to be carried out. The lines of such research are considered in the following paras :—

(iv) *Natural Regeneration.*—In view of the promising results obtained in Coorg, Tinnevelly, and Cachar, natural regeneration at present offers more hope of success than artificial. Sometimes investigations must begin with getting seedlings on the ground, but more usually the problem is getting up existing seedlings. In the average case, it cannot be expected that natural regeneration will give a full crop consisting mainly of the chosen few more valuable species, and it should generally suffice if operations result in new crop with at least as good a proportion of them. This point requires to be clearly laid down at the start, as if more is demanded, artificial reinforcement will almost certainly be required often under most difficult conditions. Fire cannot be called in as an aid in evergreen forest as it kills most of the species, and so varying manipulation of the several canopy layers is all that can be done, just as was begun in 1921 in Chenat

Nair. This work must be tried a few years before the fellings are due. How long it will take and what amount of regeneration is necessary to ensure enough surviving, the inevitable felling and extraction damage also has to be determined. Broadcasting or dibbling in seed where seedbearers are absent is only likely to be of use if the conditions under which it can succeed are thoroughly understood first.

(v) *Artificial Regeneration.*—The technique of the chief constituent species, say six of them in the first place, requires thorough study as a first step. This should be done in an experimental garden in the evergreen zone on a moderate scale, and directly the results obtained justify it, tried on an acre under forest conditions both with and without overhead shelter, as is being tried in Chenat Nair in Madras.

Where observation of former clearings or heavy fellings shows that a shift from evergreen condition to wet mixed forest conditions is to be expected, plantations, preferably with *taungya*, of species characteristic of the latter will be at least worth a trial, though it will usually be highly advisable to make trials simultaneously with the species of the evergreen. A strong burn will in all such cases be a first essential to any hope of success. In view of the inevitable luxuriant weed growth, weedings will be prolonged and costly, and therefore *taungya* is indicated wherever and whenever possible. Where it is not possible on account of lack of labour or steep gradients, plantations will share some of these difficulties, and under present conditions suitably aided natural regeneration offers better prospects.

16. CONCLUSION.

Fellings of the best trees of the best species without appropriate cultural operations inevitably results in a marked deterioration of all types of mixed forest; in the tropical evergreen this effect is very pronounced, and that the more so, the heavier the fellings.

Natural regeneration is often present in good quantity, and having received suitable help, has in some places been established by the requisite weedings and by avoiding too sudden exposure.

Where deficient or small, its quantity can usually be increased by lightening the middle canopy and undergrowth, and to some extent by sowing or planting.

Artificial regeneration offers serious difficulties, particularly in view of the nature of the ground on which much of this forest occurs, and on the need of some shade for the early stages of its chief species—factors rendering *taungya* operations nearly impossible, when in view of the danger from weeds, *taungya* would be doubly valuable. Locally where there is a pronounced dry season and where the evergreen type has probably been invasive in the past, *taungya* and plantations of trees of the moist mixed type should succeed. In the most pronounced forms of evergreen with well distributed and heavy rainfall, *taungya* with technique adapted to the special requirements of the evergreen type species offers most prospect of success where *taungya* is possible, and where it is not, reliance must be placed on natural regeneration obtained, with some artificial help, if necessary, prior to any considerable opening up of the canopy.

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THE CO-OPERATIVE PURCHASE AND SALE OF LAC IN THE ORISSA FEUDATORY STATES.

Lac cultivation forms one of the most important cottage industries in many of the Orissa Feudatory States and constitutes an important item of forest revenue. The recent introduction of a co-operative system of purchase and sale in Bonai State and its result may prove of interest.

The most usual method of sale in the States has been to lease out the right to purchase and export stick lac to a contractor for a period of years—usually five—on payment of an annual lump sum, which gives him a complete monopoly in that State. In some cases a royalty per maund on export is levied, with a fixed minimum royalty. This system has led to much abuse in the past. It has resulted generally in the maximum of profit to the contractor at the expense of both the State and the cultivators. The latter are generally illiterate aboriginals mostly Bhuinyas and Kols, who are easily deceived and are only too often led to sacrifice their brood lac in order to increase their immediate outturn. In this respect the monopolist is often as short-sighted as the cultivator. An all too frequent feature of this system is that in the last year of his lease the monopolist clears out all the brood lac in addition to the ordinary crop leaving nothing wherewith to propagate the following season's crop. An enhanced yield is the immediate result, with a subsequent period of scarcity for two or three years.

This clearing out of all the available brood lac in a State by the contractor has become so frequent, and the whole system has been found so unsatisfactory generally that steps have been taken to introduce a system of purchase and sale through State agency. Such a method will eliminate the middleman and should give a greater profit to both the State and the cultivator. Briefly, it resolves itself into co-operative buying and selling of lac.

Departmental cultivation through the medium of the Forest Department has also been tried, but this has its drawbacks, chief

amongst which is the necessity for a large staff to supervise the work in the areas where the host trees are scattered, as they generally are. Purely departmental propagation of lac is not regarded as a practical proposition except where the trees are concentrated in large numbers, or in plantations. If, however, it is considered necessary to maintain areas for the provision of brood lac this may be done by departmental agency.

One of the chief advantages of the co-operative system is that the cultivators will receive better prices than heretofore and will thereby be stimulated to extend the industry, with increasing profits to themselves. This is most desirable in the Orissa States, as the aboriginals, who form the bulk of the lac cultivators, possess little land and are extremely poor.

The present method of collection and sale as employed in Bonai State, where this experiment was first undertaken, is as follows:—

(1) The tenants bring their stick lac to the various collecting centres in the State, which are in charge of a forest official, usually a forester. Here they are paid at a nominal rate which is fixed from time to time by the State according to the condition of the market, and their names entered in a register. This rate represents about 60 per cent. of the market price for the lac and is generally about the same as that paid by traders in the adjoining districts of British India. In any case, it is more than would have been paid by a contractor under the old monopoly system.

(2) The State Forest Department then arranges for the collection of the lac in a central depôt, where it is sorted, cleaned and kept carefully.

(3) It is then sold, usually by auction.

(4) After deducting item (1) the cost of carting and cleaning the lac, and other miscellaneous charges, the net profit is divided between the State and the tenants in the ratio of 2 to 1. This leaves the State a fair profit and gives the cultivator the best price possible. A small commission is paid to the staff responsible for the collection.

The State covers itself against a possible fall in the market rate (unless it be a phenomenal one) by not paying an excessively high nominal rate in the first instance and at the same time can afford to pay the best price possible to the cultivator by eliminating the middleman and by taking only a reasonable share of the profits.

It is of interest to compare the results of this system (or, rather, one closely akin to it) since its introduction into Bonai State in 1926-27 with the conditions prevailing under the monopoly system :—

Year.	Summer Crop	Winter Crop.	Total
	Maunds.	Maunds.	Maunds
1926-27	363	959	1,322
1927-28	403	1,002	1,405
1928-29	611	1,457	2,068

Prior to 1926-27 the annual amount said to have been exported by the monopolist was only about 500 maunds—an obviously incorrect figure. There was little or no check on export and a good deal is said to have been smuggled out of the State by the cultivators for sale in British India, where they could get better prices. The monopolist held his lease for five years on an annual payment of Rs. 4,300.

In 1926-27 the net profit derived by the State under the departmental purchase and sale system was Rs. 15,000, and in 1927-28 it rose to Rs. 28,000. It must be explained that the method followed during these two years was not identical with that described earlier in this article. The raiyats only received one payment and got no subsequent share of the profits. Even so, the cultivators got better prices than before and the industry is rapidly expanding. It is expected that under the co-operative system which has been outlined above the financial results of working will be somewhat as follows :—

Assuming that the price of T. N. Shellac is Rs. 90 the State may reasonably hope to get Rs. 56 per maund for its stick lac. The cultivators will receive in the first instance annas 12 per seer, or Rs. 30 per maund, on delivery at the collecting centres. The cost of bags, cleaning, commission, carting, loss through drying, etc., will amount to about Rs. 5 per maund, leaving a net profit of Rs. 21 per maund. Of this the State will take Rs. 14 and the cultivators will receive a further Rs. 7 per maund, or about annas 2-9 per seer. Thus the raiyat will receive in all about annas 14-9 per seer and the State about annas 5-6 per seer.

The monopoly system has done much in the past to kill the lac industry in many of the Orissa States, and actually did kill it in some of them. The adoption of co-operative methods of purchase and sale would appear to be the system best calculated to resuscitate it.

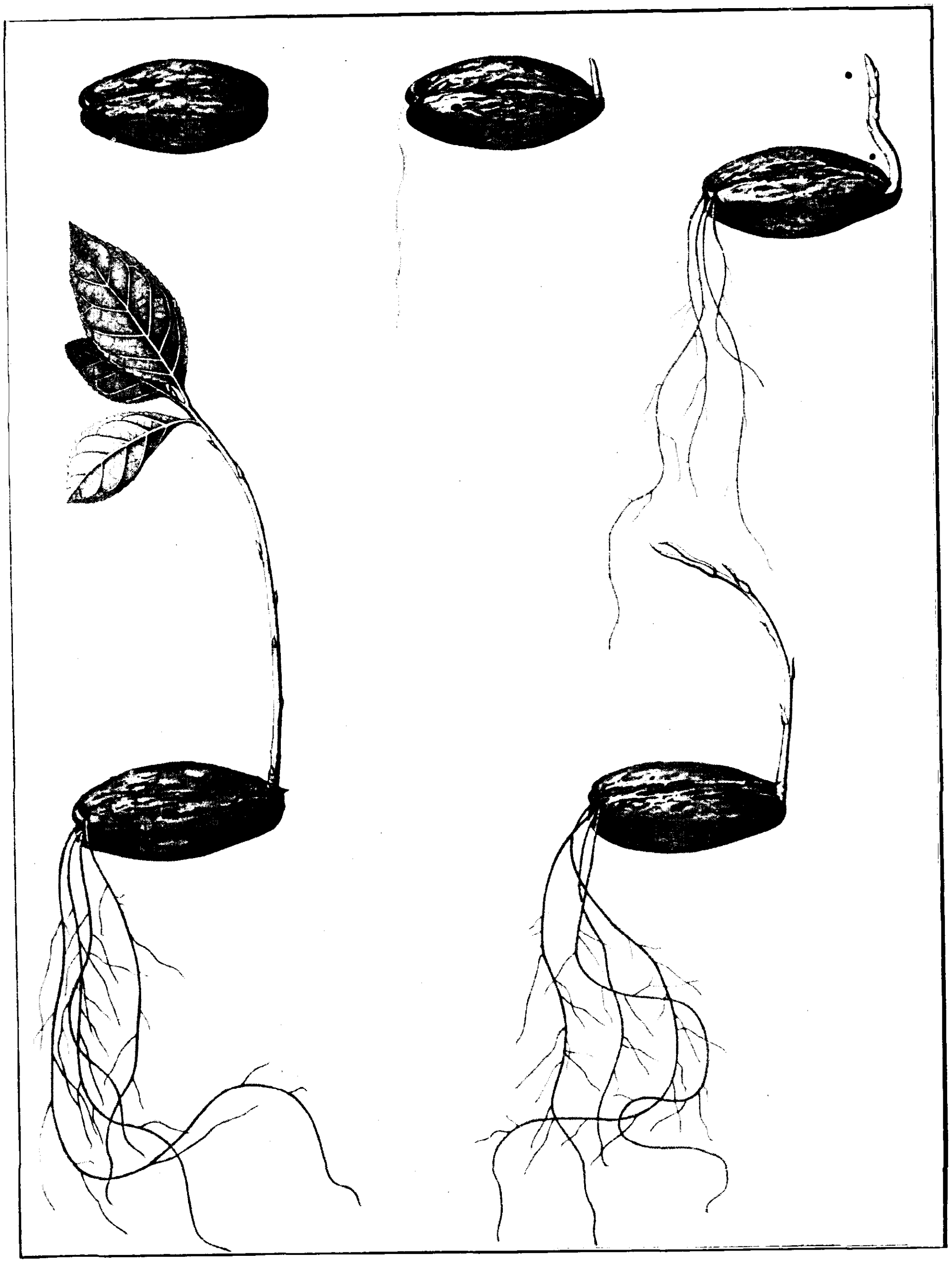
J. N. GHOSH,
Forest Officer, Bonai State.

BARRINGTONIA ACUTANGULA, GAERTN, VERN. HIJAL (BENGALI).

This little known species has been under the observation of the writer for the last three years in Assam where it grows abundantly in low lying areas. There are certain interesting facts in connection with its growth and development which are recorded in the following notes :—

Literature on this species is rather meagre. Short notes have been made in their books by Brandis, Gamble, Troup and others, but none have gone into any great details. In the *Indian Forester* for November, 1922, Mr. Trafford, then Conservator of Forests, Assam, recorded certain notes with an excellent photograph, and in the May number of 1923, the writer noted a few observations. No other literature is known.

Germination and other means of reproduction :—During the rainy season almost all localities where the species grow, go under



Ganga Singh, Del.

Barringtonia acutangula, Gærtn.

water and most of the ripe fruits that fall, perforce remain floating on the water. The size and shape of the fruit resemble that of *Terminalia Chebula*, and its outer coat is fibrous like a cocoanut which helps it in keeping afloat for a very long time. Fruits have been found on the tree twice in the year, once in August-September, again in December-January, but examination of the cold weather fruits revealed that most of the seeds were small and unsound, being bored by a lepidopterous larva; they are perhaps barren as no germination was observed near the parent tree although many seeds were found lying on the soft moist ground suitable for their germination. The first lot of fruits which ripen during August-September drop on the water. They may be floating for days together and germinate only when they come into contact with the soil after the water has subsided from under the parent trees, or may be drifted by wind and current miles away from the parent trees and deposited on the high banks of rivers and lakes where they strike root and begin life as young seedlings. This accounts for the rather peculiar phenomenon of the first growth of *hijal* trees in lines and arcs of circles. Mr. Trafford stated in his note quoted above that apparently this plant reproduced under water. The writer pointed out that several factors had to be taken into consideration in connection with the germination of this species. The writer did not find one instance in which the seeds gave out roots while floating on the water or of submerged seeds germinating under water. Where the plants grow in groups, seedlings are scarce directly under the trees, but can be seen in profusion a little away off out in the open.

To find out the percentage of the germination, the writer sowed 384 seeds in a seed bed of clayey loam during the second week of August, 1926, (first lot of ripe fruits), and when counted in December 1926, the percentage of germination was found to be 83, most of the germination having taken place in September. One of the seed beds was hoed to make a vegetable garden, and it is interesting to record that the germination of the dormant seeds went on during January to March under cauliflower plants. This will show that the percentage of germination is much higher

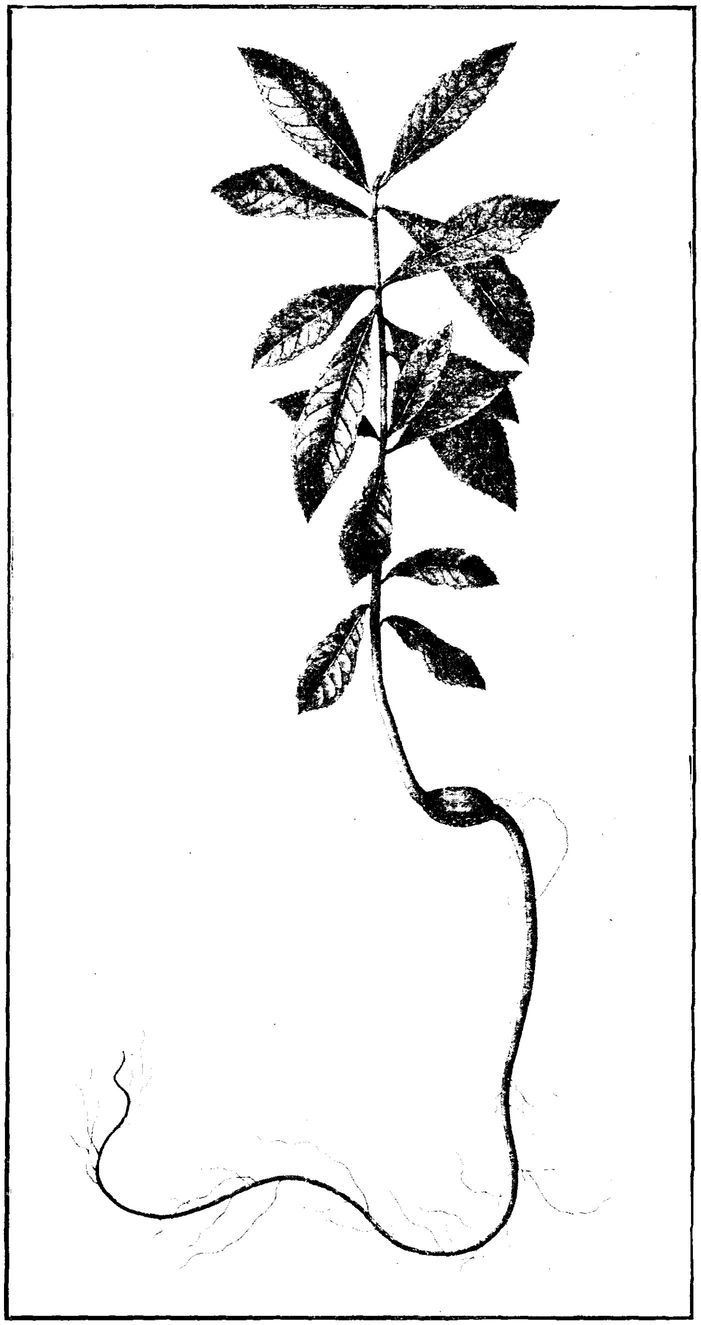
than 83, but the writer has not been able to determine it more accurately.

The plates show the various stages of germination. Seeds lie on the soil horizontally; the radicle comes out of the upper end and when it is about 1" to 2" long, the shoot makes is appearence at the opposite end, *i.e.*, the stalk end. Unlike other plants, it has very often two tap roots. If by chance, the tap root is damaged two or more thinner roots take its place. The root development is much more rapid than the shoot in the early part of its life. Two-year-old seedlings dug out at random from the nursery beds gave the following measurements :—

Length of shoot.			Length of longest root.	
11·5" ..	...	...	20·5"	(2 tap roots).
15" ...	...	...	33"	,,
17" ...	...	...	28"	,,
20·6" ...	...	...	34"	,,

Ten stumps were made from one-year-old seedlings by pruning back all but 3" shoot and 6" root and these were planted in August, 1927. When inspected in August, 1928, every one of the them was healthy, and the new shoots were as big as those of two-year-old seedlings. Billets cut for fuel and stacked have been found to give out new shoots, although they die in the long run. To find out if the plant could be reproduced by cuttings, 12 cuttings were put out in August, 1927. The first growth was very good, and every one of them gave out new shoots, but in the last inspection in August, 1928, all shoots and the cuttings were found to be absolutely dead and dry, and it was not due to a lack of moisture in the soil. It is very extensively lopped for fuel in some parts of the country and such is its vitality that within a year, it throws out profuse shoots and no sign of lopping is visible unless closely observed. But it is rather curious that with all its vitality the plant cannot be propagated by cuttings.

General characters:—It is a middle size tree with round crown, short stem, and brown to grey bark. The blaze is fleshy



Ganga Singh, Del.

Barringtonia acutangula, Gærtn.

in colour interspersed with white streaks like *Odina Wodier*. The bark varies in thickness from $\frac{1}{4}''$ to $\frac{3}{4}''$, in rather corky outside and is marked by longitudinal furrows and numerous lenticels. The leaves are light green turning yellow at the time of the leaf fall, oblong or oblong obovate to elliptic, coriacious, varying in size from 5" to 9" in length and 1·7" to 2·8" in width. The midrib is often pink in young leaves and very young shoots and leaves are copper colour. The wood is white, tough and difficult to split with an axe when dry. Although good round stems up to 12' long have been observed, it is not known ever to have been sawn for timber. Its sole use now is for fuel but it is never felled, loppings being used for the purpose. As firewood it burns well and slowly, and is in great demand for distillation of *agar* oil (*Aquilaria Agallocha*) by the indigenous method in Sylhet. The bark of the wood yields tannin.

Distribution and habitat:—The plant seems to have a wide distribution, for the writer has seen it in the low lying tracts of Assam and Bengal as well as in U. P. Owing to its rather pretty flowers, it has been introduced in gardens in dry localities like Amritsar in the Punjab, and Dehra Dun. In Assam and Bengal it grows in clayey soil in swampy localities, some of which remain under water for about 6 months in the year; during this period all the smaller plants are completly submerged leaving only the crowns of the full grown ones above water level.

Leaf shedding, flowering and fruiting:—In Assam, leaf-fall begins from March and continues up to May. New leaves begin to come out almost immediately after. But those trees that get submerged during the rainy season lose their leaves, and directly they come out of water, new leaves begin to appear. If the water level falls and rises several times during the rainy season, new leaves appear and drop off with it. Very young leaves have a beautiful copper brown colour which gradually changes into light to deep green.

The plant appears to flower throughout the year except February to May. The usual flowering takes place in May-June but it continues without break up to January. The flowers hang in beautiful pendulous racemes. It is quite a

common phenomenon to see buds and ripe fruits on one and the same tree.

R. N. DE, I.F.S.

Divisional Forest Officer, Garo Hills Division, Assam.

No other records have been traced, except (i) the brief remarks on the *Barringtonia* Working Circle of the 1923 Working Plan for the Gorakhpur Division, United Provinces, where it forms the main crop but the silviculture is evidently very little known, and (ii) a reference in the Research Report of Burma for 1923-24, recording that growth is so slow in Arakan that the cost of formation and tending are likely to be prohibitive in connection with making plantations in swampy areas.

A few experiments have been made with the species in Dehra Dun, using seed from planted local trees. Two definite crops have not been noted, the fruits being collected when they fall at the end of November and sown at once. Germination begins in April and continues for about six weeks or more, plant per cent. being about 60, and the height about 8″ at the end of the growing season. They stand the winter well enough and the best reach 2′ in the second year. Numerous roots as opposed to a single radicle appear to be the usual condition, and one seedling continued growth for two months with no roots at all. Stumps with 1½″ stem and 9″ root—a good tap root was found to exist in almost all cases despite the appearance in the first year—planted out early in August strike very easily even in a very unfavourable monsoon followed by severe frost in the cold weather, for 90 per cent. survive after two seasons. Growth is however very slow the average height after two seasons being only about 10″ or hardly bigger than the original plants, but it should be remembered that the experiment was done in ordinary well drained soil, providing unnatural conditions for the species.

The distribution is much wider than might appear from the paper for the species is characteristic of fresh water swamps all over the warmer parts of South East Asia, and Northern Australia and the intervening islands.

H. G. CHAMPION, I.F.S.

Silviculturist, F.R.I.

PRIZE-DAY AT THE BURMA FOREST SCHOOL, PYINMANA.

The annual prize distribution took place at the Burma Forest School, Pyinmana, on Tuesday, April 30. The Hon. Minister for Forests, Sir Lee Ah. Yain, travelled to Pyinmana from Maymyo to attend the function.

The Hon. Minister was accompanied on the platform by the following officers:—Mr. H. W. A. Watson, Chief Conservator of Forests; Major R. W. Barker, Deputy Commissioner, Yamethin District; Mr. H. R. Blanford, Conservator of Forests, Hlaing Circle; Mr. D. P. Hewett, Conservator of Forests, Working Plans Circle; Mr. C. W. Scott, Deputy Conservator of Forests and Forest Economist, Utilization Circle; Mr. D. W. Hughes, Deputy Conservator of Forests, Pyinmana Division; Mr. D. E. B. Manning, Deputy Conservator of Forests and Director, Burma Forest School.

The Director of the School gave an account of the work done during the year. Speeches were made by the Chief Conservator of Forests, Burma, and the Hon'ble Minister for Forests who also distributed the medals and prizes.

EXTRACTS.

RECRUITMENT TO THE BURMA FOREST DEPARTMENT.

Extract from Burma Forest Administration Report for the year ending 31st March 1928:—

The response to the advertisement for candidates for the 1928-31 Forestry course was exceptionally poor. Only seven qualified candidates applied for the 12 vacancies advertised. It seems obvious that the comparatively hard life in the Forest Department is not attractive to the educated sons of the province. The matter of supply will no doubt right itself in time. The matter of quality of the material presents a more difficult problem. The Forest Department requires men with a natural bent for a hard outdoor life and such men are rare amongst the more highly educated classes in Burma.

IRRIGATED PLANTATIONS.

The sites for the two remaining plantations in the Nili Bar, of approximately 10,000 acres each, have been finally selected in

the neighbourhood of Arifwala and Dipalpur, two important centres in the new colony. Each plantation will be about 10 miles distant from the nearest railway station. The quality of the soil is reasonably good; and these plantations may be expected to be very successful, since they are not too far to the west, and so will have the benefit of a somewhat better rainfall than places like Khanewal and Miranpur. Even in the case of irrigated plantations rainfall is of greater importance than is sometimes realised. With the allotment of these last two plantations and the handing over of all the Nili Bar rakhs for colonization the Forest Department has reached almost a stage of equilibrium. From paragraph 1 of this report it will be seen that during the year 1,114 sq. miles of forest were disforested for colonization; and that the area under the control of the Forest Department at the close of the year was 5,534 sq. miles. Out of this roughly 5,000 sq. miles consist of commercial and protective forests in the hills and foot-hills. These are essentially forest areas, and must remain as such in the hands of the Forest Department. The balance consists mostly of scattered areas in the plains, which have not so far come under any colonization scheme. The disposal of these areas is now under consideration. Some of them may come within further canal projects which are envisaged in the future; while others are not commanded by any flow irrigation, and can only be made cultivable by some method of lift irrigation. In the meantime they are in the hands of the Forest Department, and are administered mainly as grazing grounds. It may be noted that the Forest Board, which met after the close of the year under report, expressed a decided opinion that they should remain so. Whatever may be the fate of these areas, it is on the 5,000 sq. miles of hill forest, *plus* the eight irrigated plantations, that the work of the Department will be concentrated in the future. Incidently it may be noted how meagre is the proportion of permanent forest to the whole area of the province: only just over 5 per cent. compared with the 20-25 per cent. which most civilized countries consider necessary.

(Progress Report on Forest Administration in the Punjab, 1927-28).

WHEN AN ELEPHANT SNEEZES.

Perhaps because an elephant sneezes so seldom or because he sneezes so loudly Oriental folks are very superstitious about the occurrence. They believe that to hear an elephant sneeze will bring good luck. When the huge creature is about to sneeze the natives of India gather round and eagerly await the event. Fortunately the animal gives ample warning of the coming sneeze and its keeper knows for at least half an hour in advance that something unusual is about to happen.

The elephant shows signs of agitation and is extremely restless, seeming quite unable to stand still for a single moment. Then after a tremendous bellow the sneeze comes and this resembles the bursting of a boiler of considerable size. Not long ago an elephant in a travelling circus sneezed and caused quite a panic amongst those who did not know the cause of the explosive sound. In the East after an elephant has sneezed the natives, particularly the Mohammedans, bow and start to pray for something which they especially desire. It is strange that an elephant's sneeze should be such a rare occurrence, for these creatures are suscepitble to colds.

(*The Field.*)

STRANGLING IVY.

In your issue of April 24th Mr. E. H. Hindley, advocates the cutting of the stems of ivy as a measure towards preserving trees. In this connexion a personal experience may be of interest. In the garden of this house there was a very large, and once very beautiful, wild cherry tree, which gradually became smothered in an enormous mass of ivy, and several large branches began to decay. About 10 years ago I carefully cut through every stem of the ivy about a foot above ground-level, some of these stems being as much as 3 in. in diameter. The result was that for several years the ivy flourished much as before, but the cherry tree decayed even more rapidly. Eventually the whole thing collapsed. It is obvious that the ivy was acting as a true

parasite, obtaining the whole of its nourishment from the cherry tree. It follows, therefore, that the mere cutting of the stems of the ivy is quite inefficient in the case of large plants, though, of course, in the young state it is effective.

TURNERDALE HALL, WHITBY, R. H. RASTALL.
April 25.

(*The Times.*)

A TIMBER COMPANY'S AFFAIRS.

INTERESTS IN BURMA.

A compulsory winding-up order having been made against the Lower Burma Timbers, Limited, of 69A, Chancery-lane, W.C., the statutory first meetings of the creditors and shareholders were held yesterday at the Board of Trade Offices, Carey-street, W.C. The accounts filed under the liquidation showed total liabilities £20,503 (unsecurred £17,641); assets, £1,912; and a deficiency of £52,641 with regard to contributories, the issued capital being £35,000.

Mr. J. Barwick Thompson, Senior Assistant Official Receiver, reported that the company was registered as a private company in March 1922, to acquire and continue the business of general agents and hardwood importers carried on by Messrs. P. M. Illingworth and C. K. Hargreaves at 68, Pall Mall, S. W., and generally to carry on business as timber merchants, dealers, importers, and exporters. The business was carried on in London and Tavoy, Lower Burma. The directors at the date of the winding-up order were Mr. P. M. Illingworth, Sir Archibald Earle, and the present Lord Aberdare. Mr. Illingworth had acted as managing director throughout the existence of the company.

Licences were at first obtained to extract and market timber from a forest in the Tavoy district of Lower Burma; and in December 1924, the company obtained the sole right of licence from the Secretary of State for India, through the Government of

Burma, for 40 years to fell and extract timber over an area of 270 square miles on payment of royalties. Contracts were obtained for the supply of railway sleepers, sawmills were erected, and sales of timber were effected through the services of agents.

In September 1924, the company's available working capital had become exhausted and loans were obtained from its bankers on the security of timber stocks in London. Sir Archibald Earle had stated that the company's activities throughout were in the nature of development work, and the energies of the board were directed, with the knowledge and consent of the shareholders, with the object of being in a position to raise sufficient capital by means of the formation of a public company with large capital, so that the timber licences could be worked on a commercial basis with profitable results. The attempts to arrange for underwriting a public issue were unsuccessful.

The trading of the company resulted in a total loss of £34,357. Debentures were issued in 1926 and 1927. On January 14, 1929, Mr. G. H. Robinson, C.A., was appointed receiver for the bondholders and winding-up proceedings followed.

The liquidation was left in the hands of the Official Receiver, who remarked that there appeared to be no prospect of any surplus funds becoming available for the benefit of the unsecured creditors or shareholders.

(*The Times.*)

VOLUME LV.] NUMBER 10.

INDIAN FORESTER

OCTOBER 1929.

"MUSTH" ELEPHANTS.

My first knowledge of "Musth" elephants dates back some twenty years, and the thrilling experience and exhilarating adventures which two tuskers gave me will always remain fresh in my memory.

Bholanath and Lachmi Pershad were the most intelligent tuskers of a herd of about fifty elephants and during some four or five years before the incidents which I am about to relate took place I always tried to be on friendly terms with them; they would take plantains out of my pocket and allow me to cut and dress any galls contracted at work; and they let me generally do almost anything I liked. Both were always docile, except that Bholanath had shown a great dislike for my cook who had tricked him by offering a bunch of plantains and giving a stone instead. Thereafter whenever this man came to the camp with me and the elephant spotted him in the distance he would always try to get him; and though his chains prevented him making a rush he would throw stones or anything else he could get hold of.

It seemed to me extraordinary that an elephant could remember an individual to whom he had taken a dislike the first time he had seen him, but subsequent events proved to me that this particular elephant was gifted with exceptional intelligence.

On one of my periodic visits to the camp where these two tuskers were working I sent for all the elephants for the usual inspection. The mahout of Bholanath came in and reported that on the way his elephant had met Paul—another big tusker—and had immediately rushed at him head on; Paul was game for a

fight, and the two mahouts could do nothing to stop them. They had to get off their backs or they would have been thrown off. The contest lasted for some time, until Paul ran off into the jungle with Bholanath after him. Bholanath had then come across Bhokaung—another tusker—and had gored him badly. On further enquiry it appeared that Bholanath had shown slight signs before of getting "Musth" but had been quite docile until he met Paul that day. Just then as the man was talking some men rushed into the camp, shouting, "Bholanath ata hai", and it was not long before I saw him through the trees approaching the camp with longer strides than usual, his head was well up in the air, and he had a determined look about him. There were several other elephants tied up in camp, which we were able to unfetter and get away, except a nervous female who was so frightened and so straining on her chains, that the mahout could not release her in time. Bholanath went up and tried to induce her to follow him, but she only screamed ; and in his fury he knocked her down. Bholanath's mahout then rushed up and the elephant in trying to attack followed him, so that we then were able to release the female. Bholanath's mahout found shelter behind a tree and from there tried to ward him off with a spear. Bholanath tried to push the tree—which was about four feet in girth—on top of the mahout and nearly succeeded, we therefore rushed up and the elephant then chased us, but all found shelter behind large trees. After thus playing about the camp for an hour or so he cleared off into the jungle and gave us time to consider the situation.

All our animals were now at large, most of them without fetters to enable them to get away from Bholanath. We had no shelter for the night except a few leaf huts which the elephant could easily knock over; there was an inspection hut on a little hill with some hundred steps leading up to it, but I decided to stay the night with the rest of the men.

During the early night we heard a crash from the hut where some of my servants had remained and shortly after one of them came down to inform us that Bholanath had walked up the steps and pushed over the hut while they had remained quietly inside the roof of the over-turned hut till the elephant walked off again.

We settled down to rest again until about 3 o'clock in the morning, when we heard an awful yell near by. On rushing out we were told that Bholanath was ten yards away. He had put his trunk into one of the huts where two men were sleeping. One of them, when he felt the breath from the elephant's trunk on him, got away and awoke his companion, whom, however, the elephant managed to get. We shouted and fired a few rounds and then advanced towards where some one was groaning. Bholanath had by this time disappeared and the injured man was lying under a fallen tree; we brought him to our hut where after a dose of brandy he somewhat recovered. He told us that while he was getting out of his hut, Bholanath had caught him up and kicked him but he had managed to crawl under a tree. Bholanath had followed him and dug his tusks all around him, but on hearing our shouts the elephant had run away.

This man had a miraculous escape, a bruised red and blue patch on the small of his back showed a distinct outline of the sole and toe marks of the elephant's fore-foot, yet, except for a few days stiffness, he was quite all right. Next day, when examining the spot where the man had found shelter, we saw from the way the ground was dug up all around that the elephant could only have missed him by a few inches.

The following morning Bhokaung was brought in with a wound about a foot deep in his buttocks, and report came in that Bholanath had pulled down in the next camp a newly constructed building about 100 ft. by 40 ft. We at once set off but on our arrival he was said to be near by in the jungle. That being so, we set about digging a pit for a trap and were just covering it with brush wood when Bholanath turned up, we climbed into the fork of a big tree; and Bholanath not being able to get at us started knocking down all smaller trees near by, so that the crowns struck us and we had several narrow escapes from being thrown from our perch. When the beast went off again we collected as many elephants as we could and sent them to a camp on the sea shore about thirty miles away.

After spending a few days at Headquarters, I went by launch to the new camp. We had hardly landed there when a

report came in that Bholanath had turned up and was chasing Paul.

We came across Bholanath in a cane-break and, as there was no chance of shelter anywhere, we decided to shoot him ; the bullet went home and the animal reeled and then made off in the opposite direction apparently little the worse.

When we returned to camp, another tusker Lachmi Pershad was brought in with several females, for the daily rations. The mahout of the tusker dismounted to adjust the fetter but the elephant threw him aside with his tusks and immediately started chasing us. We had a most exciting time ; there was no shelter except a small leaf hut about 20 × 20 ft. in size and a few shrubs. Lachmi Pershad, however, behaved differently from Bholanath He chased men at full pace and several would have been hurt had he charged home through the shrubs as Bholanath would have done, or had he pulled down the hut. We walked round and round this hut for eight hours, the elephant following all the time, until at about 1 o'clock in the morning the last man was able to get away to the boat.

The position was becoming more and more exciting ; we now had two "Musth" elephants to deal with. I hoped eventually to capture them but this did not seem so easy. I expected that Lachmi Pershad with the females would renew his daily visits to the camp for paddy, and so I decided to make a stockade. We did this by winding the anchor chain of the launch round some suitable trees, leaving an enclosure sufficiently large to hold Lachmi Pershad and three females. A gate was made with the anchor tackle by passing it through several blocks four feet apart; the leading end was taken up a tree near by. In order to prevent the animal getting through the chains, saplings, shaped and hardened by fire with their points inwards were fastened to these. The stockade was ready by 2 o'clock the same day and we had barely time to get on the machan, when Lachmi Pershad arrived with his females. The latter went into the stockade at once and started feeding on the rice we had placed there ; the tusker, however, was suspicious and spotted us on the tree.

He rubbed himself for a while against the tree but eventually joined his females in the stockade. Immediately, hanging on to the leading end of the gate tackle, we slid down and closed the stockade.

Lachmi Pershad, when he saw us approach, became furious and started charging the spiked chains and he would have got through had we not jammed spears into his head. He was bleeding profusely. After some struggles and more narrow escapes we eventually secured the animal's fore and hind legs so that he could do no further damage.

Having thus quite easily secured Lachmi Pershad we hoped to capture Bholanath in the same way and erected in the jungle a similar stockade in which we tied up the female, which he had been following.

The elephant obliged us by coming to the stockade, but as soon as the female saw him she screamed and broke her fetters and rushed off in great fright, Bholanath walked at leisure round the enclosure and examined it ; but before entering to feed on paddy and sugar-cane, he carefully pulled down all the blocks of the gate so that it was useless. We now had to find other means to secure him and tried all sorts of ruses but the only possible solution seemed to be to shoot him and this I was reluctant to do, for I liked the beast and he was a very valuable animal.

After some days I collected my party for a last chase. I did not know myself how I was to get him except that I had resolved to tie him up some how, and hence I ordered a rope to be brought for that purpose.

We started out at daylight and came up with the elephant in the early morning. He immediately charged and came quite close up to a large tree behind which we had taken shelter. He put his foot into a noose lying loose on the ground and we managed to tighten it. Now we had him, but unfortunately one of the men, who held the noose, slipped over a creeper, the elephant would have got him had not his companions, a Pathan and an Afridi, who stood firm managed to divert him for a few seconds by prodding spears into his head ; but—Alas! this also

gave the elephant time to shake off the noose. More drastic action was necessary so I fired at him several times, when he charged, trying to get him in the foot but I missed every time; the elephant then began to run; we kept on his heels the whole day but he kept always fifty yards or more ahead of us so that the jungle being dense, we never saw him As it was getting dark it became necessary to look for a camping place; we had had no food all day and were over twenty miles from the camp. I was disappointed, but decided to have a last look at the elephant, and with my two companions the Afridi and Pathan I silently followed his marks. We found him standing quietly in a thicket and when he saw us he trumpeted as though he was pleased. It was not the sound of fury ; so I braced myself up and walked straight up to him and patted him on the hind quarters. The elephant did not move. I made signs to my companions quickly that they should bring the rope, Afzal brought it in a few minutes and we tied his hind legs securely together. Well pleased with ourselves we laid down on the ground near by, and slept soundly until the morning.

When we tried to take the elephant back the next day he was as savage as ever and would allow no one to approach; but that did not matter now, he was in our control and could not escape. We now saw that he had a bullet wound nine inches deep in his head, but this did not seem to worry him yet had it been six inches higher he would have been killed.

I returned to Headquarters, and when I came to see the elephant ten days later he was still in the same place, savage. The ropes had cut deep into his legs and the wounds were fly-blown. As no one could approach him I once more made use of the launch anchor tackle and had him pulled down and his sores dressed. I instructed the man to continue the treatment daily, but a week later I found nothing had been done. They could not manage the elephant, and to everyone's intense surprise, as soon as the elephant saw me, he sat down without trouble and allowed me to dress him without showing further signs of savagery.

Thus ended our adventure without anybody being seriously hurt. There were many narrow escapes and a "Musth" elephant

knows what to do when he gets a man. I saw an elephant on another occasion put his foot on a man, pull his limbs off one by one and chuck him aside ;—but that is another story...!

M. BONINGTON, I.F.S.

[*The scene of the above account is the Andaman Islands where Mr. Bonington has been for many years. We hope to publish further interesting articles by the same author including his last experiences with Lachmi Pershad. Hon. Ed.*]

AN INVESTIGATION INTO THE PLANT REQUIREMENTS OF ZIZYPHUS JUJUBA DURING GROWTH AND UNDER LAC CULTIVATION. PART I.

By Dorothy Norris, M. Rangaswami, M. Venugopalan and S. Ranganathan.

Introductory.—Experiments have been carried out at various times to find the seasonal, daily and even hourly variations of important food constituents in different plants.

Chibnall[1] published a series of investigations on the diurnal variations of different nitrogenous compounds in the leaves of runner beans in connection with his experiments on the nitrogen metabolism of higher plants. Researches have also been conducted on the seasonal variations of constituents such as nitrogen and potash in the different organs of the plant as a result of seasonal translocation processes. Combes [2, 3, 4] for example has published a series of papers on the autumnal migration of nitrogenous compounds in the oak to support the theory of migration of nitrogen from the leaves to the stems and roots during the yellowing of leaves. Sabalitschka and Wiese[5] observed a reduction in potash in the leaves of *Populus nigra* and *Hedera helix* in autumn and suggested a possible translocation of this element to the permanent parts of the plant during this period.

More recently Sampson[6] has carried out an interesting series of experiments on the coconut palm giving a comparative series of analyses of different parts of the plant at different stage of its growth.

These researches are not however necessarily applicable to the growth and development of plants which serve as hosts for the lac insect. As these insects are parasitic on the plant through their entire life cycle, the latter has to make good the drainage on its resources as the result of this attack besides seeking nutrition for its own growth.

This in conjunction with the fact that the insect thrives well on a comparatively small number of plants would lead one to suppose that these plants differ in a marked manner from others. The following brief list of well known lac hosts shows that they are by no means limited to one botanical family nor that a closely allied species to a known lac host will itself be one.

TABLE I.

Lac Host.	Family.
Schleichera trijuga ...	... Sapindaceae.
Butea frondosa ...	... Leguminosae.
Zizyphus Jujuba ...	... Rhamnaceae.
Zizyphus xylopyra ...	... Rhamnaceae.
Ougeinia dalbergioides	... Leguminosae.
Acacia Catechu ...	... Leguminosae.
Cajanus indicus ...	... Leguminosae.
Flemingia congesta ...	... Leguminosae.

The first few in the above table are trees whereas the last two are shrubs which yield lac in certain districts. The above list by no means exhausts the number of different hosts known for lac propagation and is merely given to indicate the variety.

The object of the present investigation of which this paper forms a preliminary part is to endeavour to ascertain by comparative analyses of known good and bad hosts whether the total amount or the distribution of the main chemical constituents or the ratio in which they occur plays an important part in the suitability or otherwise of a tree to serve as a host for the lac insect.

Experiments were started therefore with the idea of studying the distribution of the inorganic constituents in *Zizyphus Jujuba* at various stages of its growth and also to find out the manurial requirements of sufficiently well grown plants with reference to the impoverishment of the plant due to lac cropping.

The analysis of the soil in which the experimental seedlings were grown is shown in Table II.

TABLE II.

Chemical analysis of soil.

Organic matter	1·95 %
Insoluble mineral matter	92·16 %
Lime as CaO	0·09 %
Magnesia	0·15 %
Phosphorus	0·026%
Potash	0·031%
Sodium	0·150%
Total nitrogen	0·040%
Available Potash	0·012%
Available Phosphorus	0·0008%

Experimental.

The first sample was collected in August, about two months after germination of the seeds, and the third and fifth samples in August of the two following years respectively. These three samples will therefore represent the condition of the plant in the mid-rainy season at three different stages of its growth. The second and fourth samples were collected in January of two consecutive years and therefore respresent the condition of the plant a short time before leaf-fall.

A representative sample was made up in each case by picking out seedlings of different sizes and from different portions of the area. They were immediately separated into leaves, stems and roots, washed to remove soil, etc., and dried at 100°—110°C. The three portions were taken up for analysis separately.

As these researches were more or less of a preliminary nature the analyses were confined to the determination of ash and important ash constituents, though perhaps the more recent methods of sap analysis would give a better idea of the amount of food material actually available in the plant.

The following table shows the results obtained.

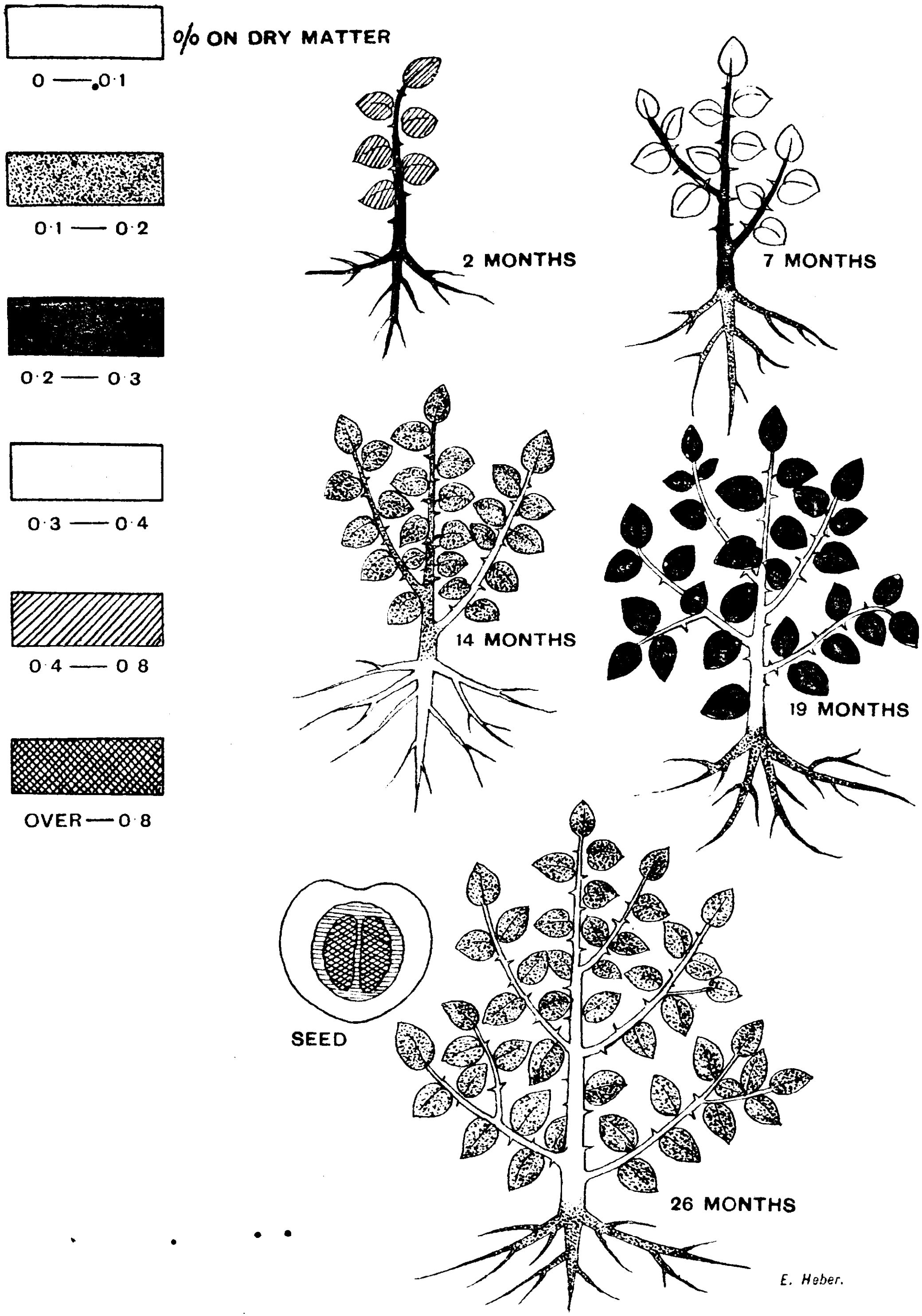
In order that the variations of the different constituents may be easily followed the result of analyses are pictorially represented in the coloured plates that follow. In these the horizontal lines merely indicate space.

TABLE III.

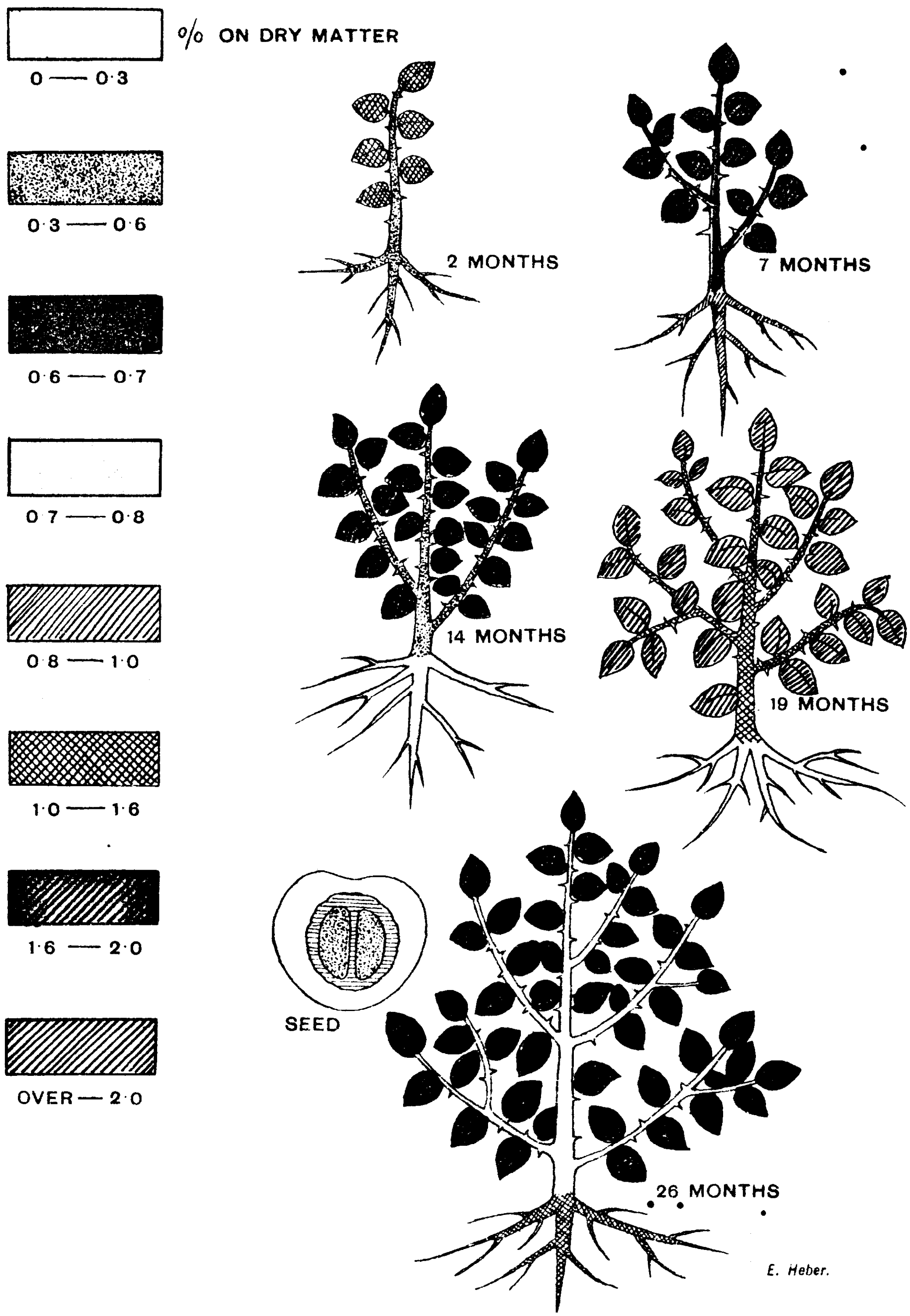
Analysis of Plant.

Samples.	PERCENTAGE ON DRY MATTER.						
	Total mineral matter.	Total Nitrogen.	Total Phosphorus	Inorganic Phosphorus.	Potassium.	Calcium.	Magnesium.
Sample I.							
Leaves ...	7·82	3·45	1·16	0·78	2·75	1·53	0·79
Stems ...	2·97	0·77	0·58	0·29	1·10	0·45	0·19
Roots... ...	2·02	0·98	0·31	0·26	0·31	0·42	0·28
Sample II.							
Leaves ...	7·75	3·23	0·53	0·32	1·21	1·61	0·26
Stems ...	3·14	0·97	0·36	0·26	0·69	0·66	0·24
Roots ...	2·75	0·63	0·18	0·18	0·41	0·83	0·26
Sample III.							
Leaves ...	8·00	2·91	0·37	0·18	2·04	1·63	0·54
Stems ...	3·21	0·78	0·19	0·14	0·90	0·56	0·18
Roots ...	3·10	0·84	0·17	0·06	0·80	0·77	0·27
Sample IV.							
Leaves ...	6·95	2·68	0·53	0·25	1·62	2·02	0·63
Stems ...	3·18	1·22	0·10	0·09	0·74	1·02	0·31
Roots ...	2·99	0·45	0·16	0·14	0·75	0·75	0·20
Sample V.							
Leaves ...	8·34	2·99	0·47	0·20	1·99	1·75	0·41
Stems ...	3·89	1·06	0·16	0·08	0.76	0·23	0·14
Roots ...	3·60	1·08	0·11	0·11	0·62	1·11	0·28
Seed.							
Shell	5·05	0·69	0·12	0·06	0·25	0·20	0·05
Kernel ...	3·07	7·07	1·40	0·94	0·19	0·35	0·30

INORGANIC PHOSPHORUS



CALCIUM


% ON DRY MATTER
0 — 0·3
0·3 — 0·6
0·6 — 0·7
0·7 — 0·8
0·8 — 1·0
1·0 — 1·6
1·6 — 2·0
OVER — 2·0
2 MONTHS
7 MONTHS
14 MONTHS
19 MONTHS
SEED
26 MONTHS
E. Heber.

Discussion of results.

In the interpretation of the foregoing results one difficulty will obviously be experienced. As these periodical analyses have extended over a period of two years, the question of seasonal variations of the different factors as well as the changes due to the growth of the plant have to be taken into account and in the discussion of the variations of any constituent both these effects have to be considered.

Mineral matter.—As usual, the leaves of the plant, by reason of their containing many more living cells, are richer in ash than are the stems and roots. As will be seen from the tables this is a result of a much higher content of phosphorus, calcium and potash in the leaves than in the other parts of the plant.

There are no great variations in the ash content of the leaves. Though in samples II and IV, which approximate to the conditions just before leaf-fall, small reductions are observed, it will be seen that the increase in the mineral matter of the last sample, which is collected at the same time of the year as the first, is very little. These slight variations in the season are perhaps due to a translocation of the soluble mineral constituents from the leaves to the stems and roots during the yellowing of the leaves.

The mineral matter in the stems and roots, more particularly in the latter, steadily increases as the plant grows.

Nitrogen.—In general, the variations of nitrogen, though not considerable, are sufficiently conspicuous.

In the samples collected in August the nitrogen contents of leaves are higher than those of leaves collected in January. This would mean that during the yellowing of leaves the nitrogen of the leaves is translocated to the other parts of the plant.

Combes[7], experimenting with oak, found a definite decrease in the nitrogen of the leaves during autumn and a corresponding increase in the nitrogen of the stems and roots at the same time. Snider and Hein[8] observed a decrease in the nitrogen of tops of sweet clover in the autumn with an increase in the nitrogen of the roots. Chibnall found a decrease in the nitrogen of the leaves of

Phaseolus vulgaris in the autumn as a result of the migration of this element to the stems and roots.

The present experiments on *Zizyphus Jujuba* are therefore in agreement with the foregoing researches as whenever there is a decrease in the nitrogen of the leaves collected in the autumn there is an increase in either stems or roots or both and *vice versa*.

As regards the changes in the nitrogen content due to the age of the plant, there is a slight fall in the leaves of the last sample, but this is more than compensated for by the slight increase in the stems and roots.

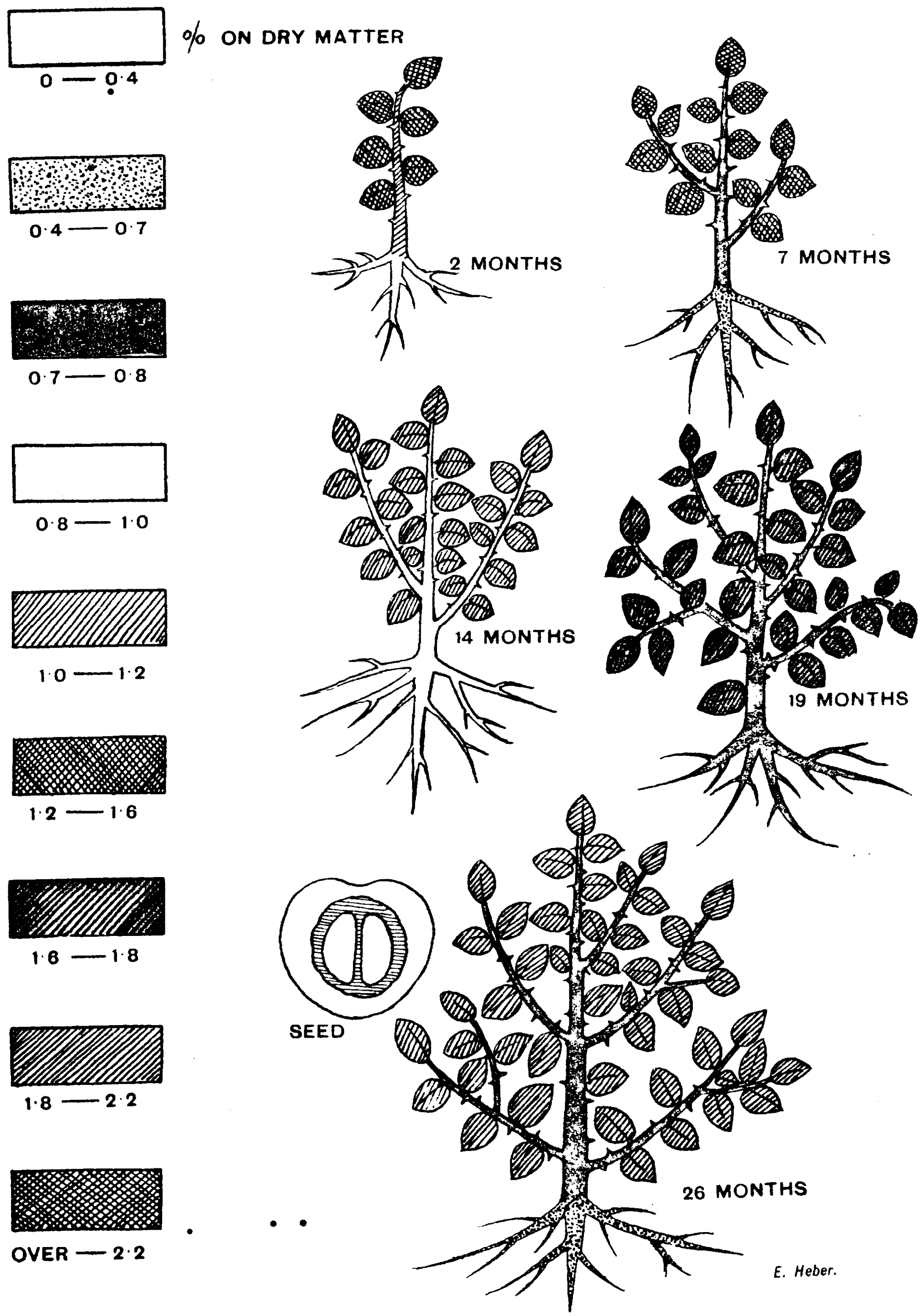
Phosphorus.—As regards phosphorus, it will be seen that there is a reserve of this constituent in the kernel of the seed to the extent of 1·4% for the young seedling. The greater part of this is transferred to the leaves and is gradually used up as very little of this element is available to the plant from the soil. With the exception of a single increase in the leaves between samples III and IV, the total phosphorus continues to fall in all the three principal parts of the plant. The distribution is the same in every case, the leaves containing most and the roots least.

Phosphorus soluble in dilute acid, which is supposed to represent the element in the inorganic form, also shows a steady fall as the plant grows with the same relative distribution in leaves, stems and roots as the total phosphorus.

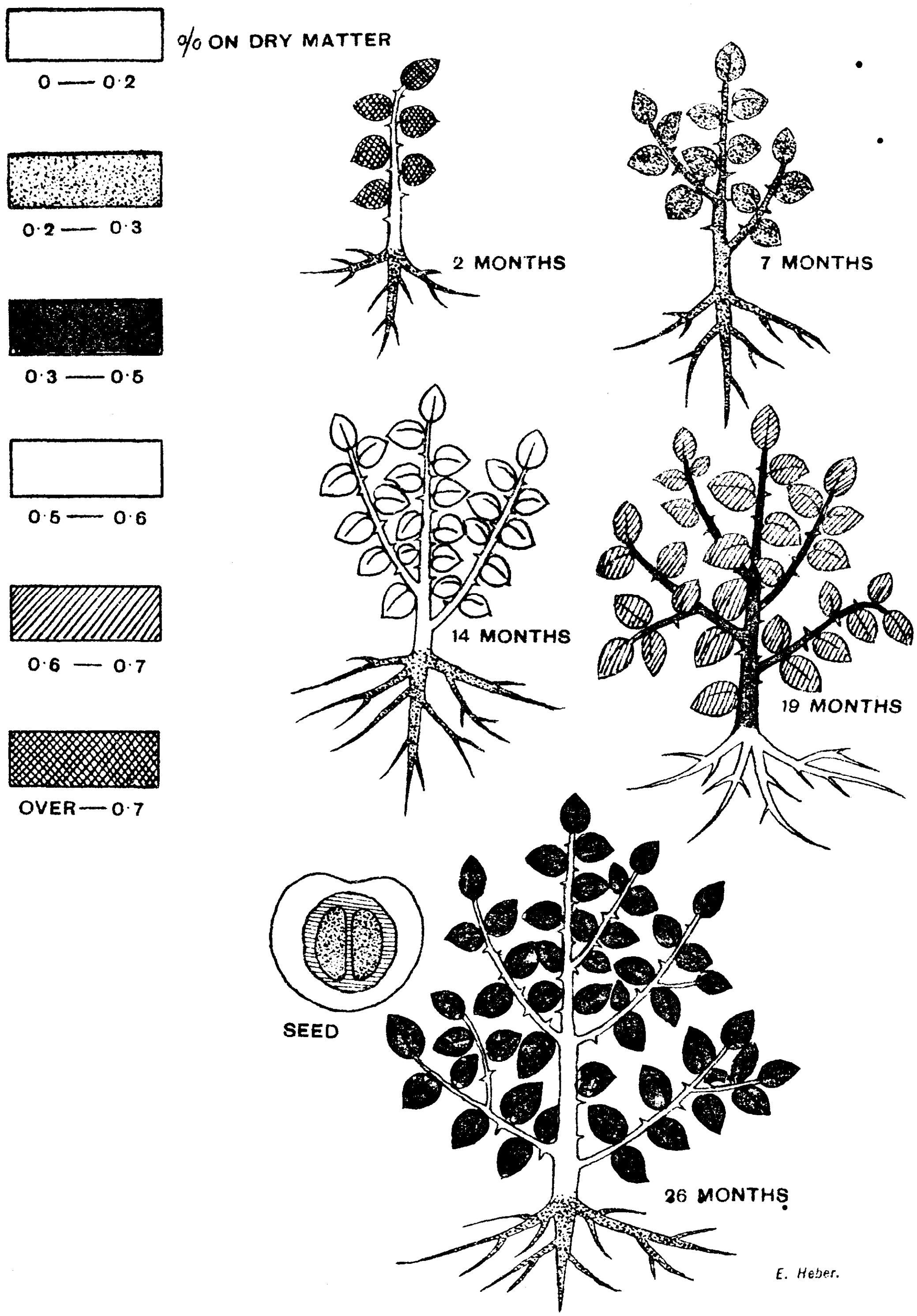
The actual requirement of this element in the older plants is not known, nevertheless, there appears to be a deficiency of this element which is more or less responsible for the stunted growth of the plant.

Potassium.—The amounts of this element contained in different parts of the plant show a regular rise and fall according to the season of sampling. There are falls in the second and fourth samples collected in autumn but the increases in the following seasons do not generally compensate for the fall, so that there is a gradual fall in the potassium content of the plant as it grows.

POTASSIUM


% ON DRY MATTER
0 — 0·4
0·4 — 0·7
0·7 — 0·8
0·8 — 1·0
1·0 — 1·2
1·2 — 1·6
1·6 — 1·8
1·8 — 2·2
OVER — 2·2
2 MONTHS
7 MONTHS
14 MONTHS
19 MONTHS
SEED
26 MONTHS
E. Heber.

MAGNESIUM


% ON DRY MATTER
0 — 0·2
0·2 — 0·3
0·3 — 0·5
0·5 — 0·6
0·6 — 0·7
OVER — 0·7
2 MONTHS
7 MONTHS
14 MONTHS
19 MONTHS
SEED
26 MONTHS
E. Heber.

Reference may be made in this connection to the work of Sabalitschka and Wiese[5] on ivy and black poplar in the course of which they observe a translocation of potash from leaves to stems and roots during autumn resulting in an accumulation of this element in the latter. In the present instances, however, there are simultaneous rises and falls in the percentage contents of potash in the leaves as well as in the stems and roots, with the exception of the last sample in which a small fall is observed in the roots from the figure for the previous sample.

However, if the actual amounts of potash present in the plant are taken into consideration, there is a much greater increase in the leaves from January to August than in the stems and roots. For instance, the following were the actual quantities of potash present in samples II and III.

TABLE IV.

	Sample II. a	Sample III b	Increase. b/a.
Leaves	0·485 gm.	3·36 gm.	6·9
Stems	0·586 ,,	1·37 ,,	2·3
Roots	0·562 ,,	1·54 ,,	2·7

It will be seen therefore that though there is an increase in the potash content of all the three parts in sample III over the corresponding figures for sample II, the increase in the leaves is much more than in the stems and roots.

Besides the consideration of seasonal variations, if we compare samples I, III and V which were collected in the same season, it will be observed that a regular decrease in potash in all the three portions of the plant is apparent. It will be observed also on comparing these three samples for calcium that this element gradually accumulates as the potash content decreases with the age of the plant.

One more point is also worthy of note. Comparing the analysis of the same plant grown in a different place,[9].

TABLE V.

Analysis of Zizyphus Jujuba.

Total ash	4·77%
SiO_2	2·5% on ash.
K_2O	44·3% „
P_2O_5	2·14% „
CaO	10·7% „

it will be seen that the potash content is very much higher than any figure obtained by us for seedlings older than 2 months. A difference is observed in the case of phosphorus as well. This would show that there is a considerable difference in the analysis of the same plant grown in a different soil and would emphasize the necessity for mentioning the age of plant, time of collection, locality and previous history when analysis is given.

Calcium.—Though the variations in the amounts of this element are not so regular as in the foregoing ones, in general, there is an increase in the calcium content of all the three parts of the plant, more particularly of the stems and roots. The sudden fall in the stems of the last sample is however inexplicable.

It has been found from experiments with beech leaves [10] that calcium and silicon show an increase as there is a decrease in potash and phosphorus. This is further supported by the experiments with *Zizyphus Jujuba* in so far as the variations of potash and calcium are concerned.

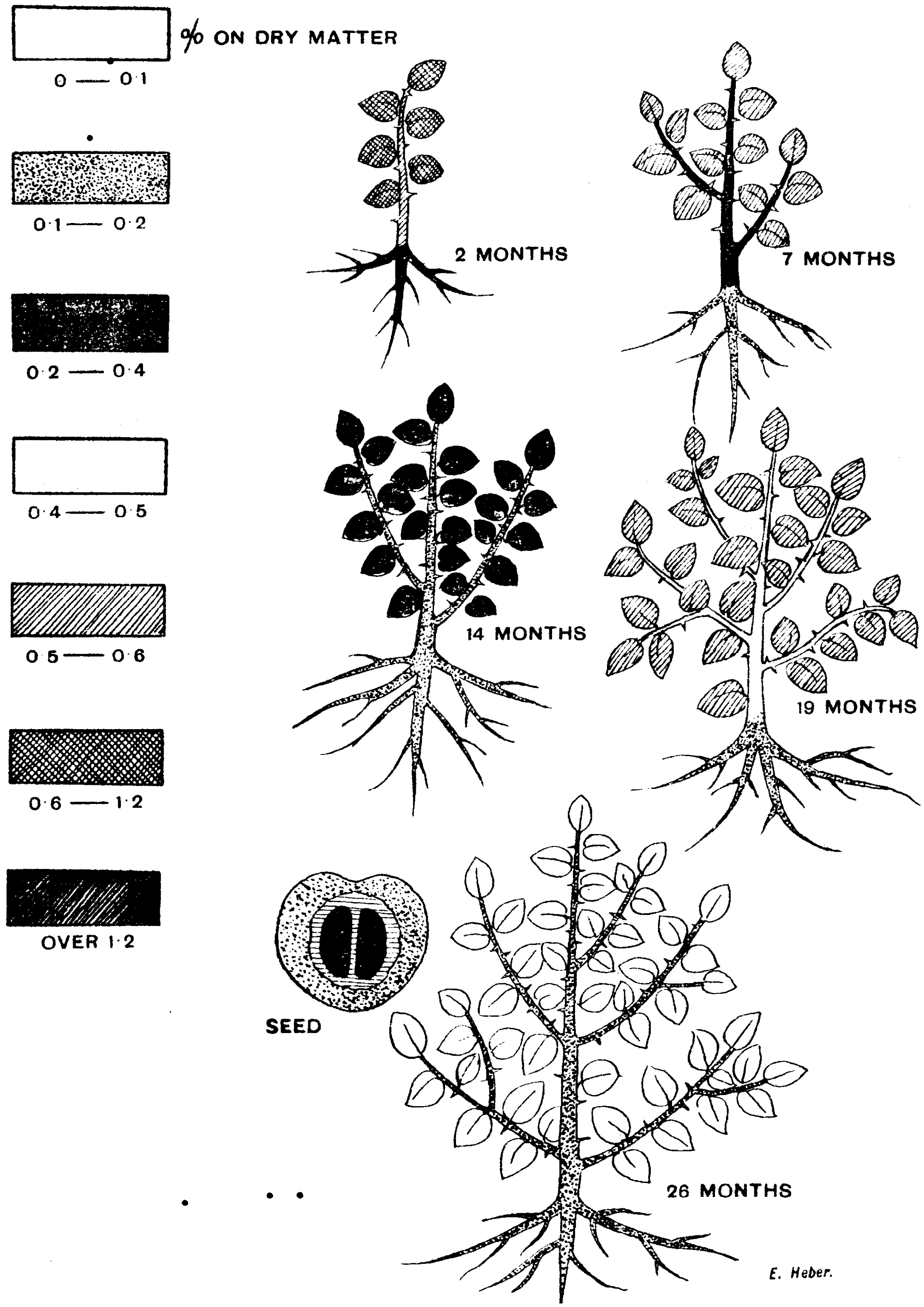
Magnesium.—Comparing the leaves of samples I, III and V, a gradual fall is apparent.

As regards the distribution of magnesium in the plant, no conclusion can be drawn but, in general, there seems to be an increase in the roots corresponding to a decrease in the leaves and *vice versa.*

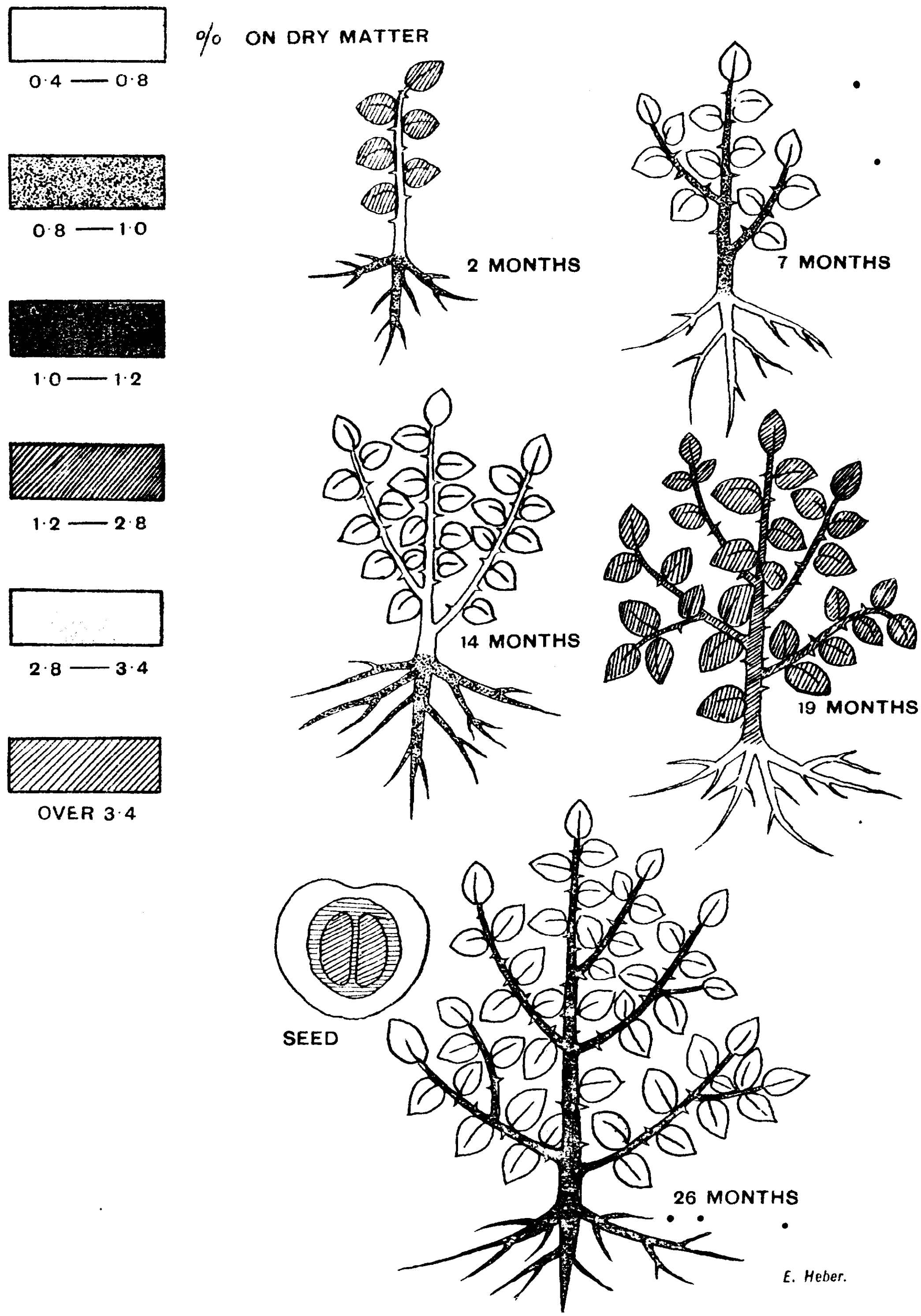
Summary.

Periodical analyses were made of *Zizyphus Jujuba* for the purpose of finding out the distribution of inorganic constituents in the plant and their seasonal variations.

TOTAL PHOSPHORUS



TOTAL NITROGEN



Total nitrogen in the leaves collected in January is less than that contained in leaves collected in August; also, when there is a decrease in the nitrogen of the leaves, there is an increase in either stems or roots or both, and *vice versa*.

Both total and inorganic phosphorus show a gradual fall as the plant grows. As regards the distribution, the leaves contain most and the roots least.

There is a gradual fall in the potash content as the plant grows. Seasonal variations are also observed in the three portions of the plant.

Variations in the amounts of calcium and magnesium are also shown and the probable connection of the variations of calcium with those of potash is indicated.

In conclusion, our acknowledgment is due to Mr. D. N. Gupta who assisted in the earlier analyses and to Mr. E. Heber, the Artist of the Institute, for the coloured plates.

DEPARTMENT OF BIOCHEMISTRY,
INDIAN LAC RESEARCH INSTITUTE.

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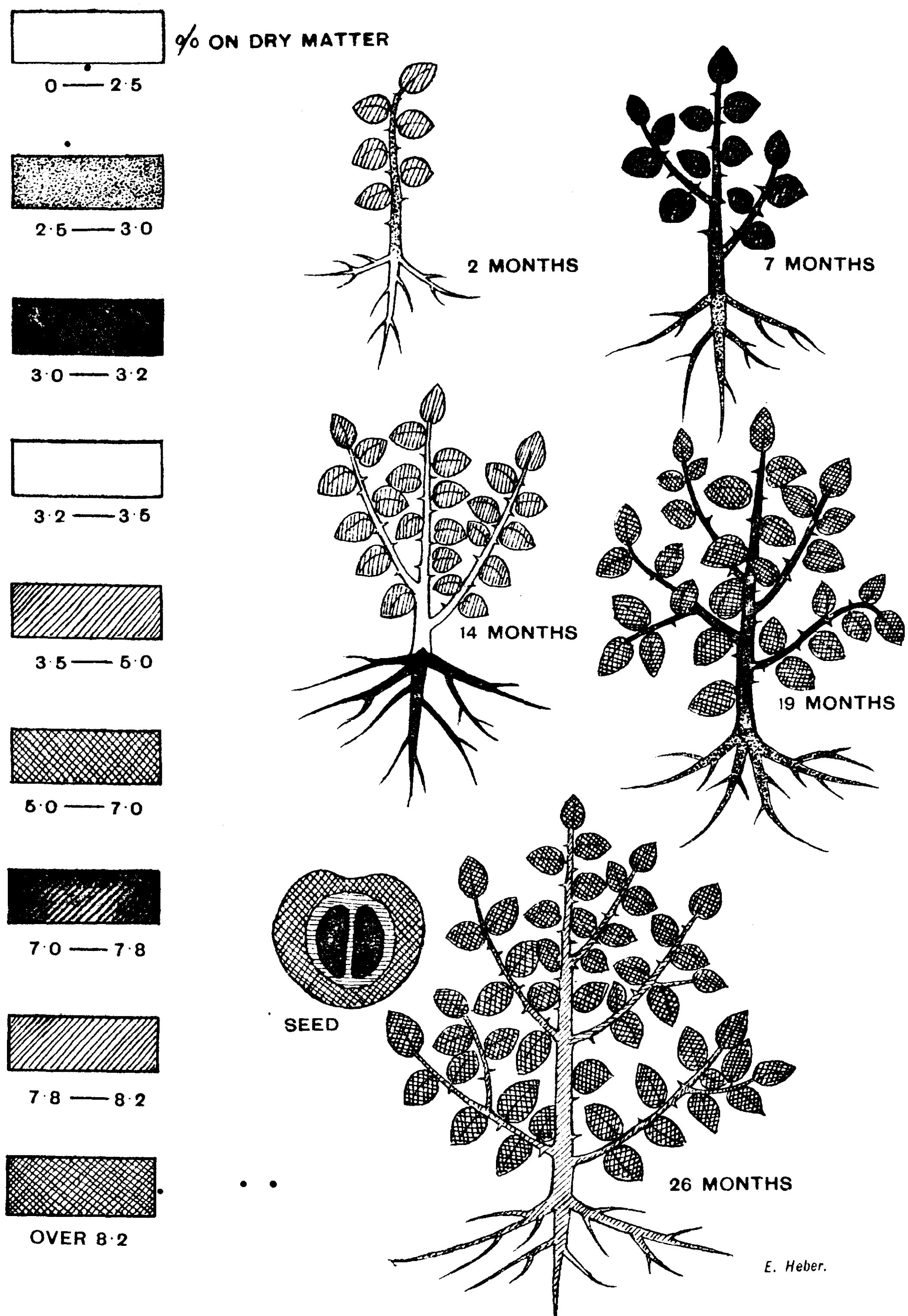
A SHORT DESCRIPTION OF UPPER BASHAHR FOREST DIVISION.

[*This interesting description of the Upper Bashahr Forest Division is one of a Series, which we are publishing, describing the more important Divisions in the various Provinces of India*—Ed.]

The Indian State of Bashahr (or Bussahir, as it was spelt on the old State postage stamps) forms a tongue of land running far into the inner Himalaya between Spiti, which forms part of Kulu, and the United Provinces as represented by Tehri Garhwal. Between these two areas Bashahr forms the Tibetan boundary, and its Tibetan marches include several recognised trade routes of which the best known is the Shipki Pass termination of the

TOTAL MINERAL MATTER



Hindustan-Tibet road from Simla. Bashahr is much the largest of the Simla Hill States as its area is 3,820 square miles, but out of this a large percentage lies under eternal snow, and a considerable part of the balance is naked cliff. The only thickly populated part is the Rohru tehsil in the Pabar valley, where the hills are open and less forbidding than in the Sutlej basin. The State forests form two Divisions of the Punjab, Upper and Lower Bashahr, and these notes concern the former, which lies entirely in the Sutlej basin.

The main approach is from Simla *via* the Hindustan-Tibet road and the divisional headquarters, Nichar, is 115 miles out. Simla is our railhead, and mule transport is our only means of communication. The postal service, however, is very well organised and dak reaches us by dak runner in 3 4 days. The Hindustan-Tibet road is well known up to Narkanda, beyond which it drops down into the Sutlej gorge to Rampur and follows the valley up to Nichar and beyond to Pu 200 miles from Simla. It is well supplied with stage rest houses, most of which belong to the P. W. D. The road crosses to the right bank at Wangtu bridge below Nichar, and remains on that side, high above the river, until near the Tibetan border. Wangtu is officially the limit of the monsoon zone and beyond this the country gets steadily drier, and for several stages before the border is reached the climate and vegetation are practically Tibetan. The people and their religion alter correspondingly, for the orthodox Hinduism of the lower valley is replaced by a mongrel cult of animism where each village has its own "deota", then further up, the "deotas" are ousted by the more picturesque Buddhist Lamas with their "gomphas" and devil dances.

Up to Nichar the monsoon is moderately heavy, with an annual rainfall of 40 to 50 inches, being appreciably heavier in the Pandrabis forests on the right bank which march with the Parbatti valley of Kulu. At Kiiba, 15 miles beyond Nichar, the rainfall drops to 32", quite half of which is of winter snow. From here onwards practically all cultivation has to be irrigated, and at Pu the rainfall is 15 inches, almost entirely in the shape of snow and with no vestige of a monsoon effect.

The configuration of the country centres round the Sutlej river which has carved for itself a magnificent gorge, with mural precipices often of 3,000 and occasionally 5,000 to 6,000 feet of sheer rock. Above this funnel of rock, which some of the more graphic early travellers referred to as "the valley of the shadow of death", the hill-sides open out into forest and upland pastures, and above these again tower the series of snow-peaks which hem in the valley on both sides. On the Kulu side the Sirikandhar rises frequently to over 17,000 feet, while between the Sutlej and the Pabar the Dhauladhar has several peaks of 18,000 feet. But the crowning glory of the valley is the Kanawar Kailas, with several peaks of 21,000 feet, towering superbly above the junction of the Sutlej and the Baspa valleys. Beyond the "Inner Line" which restricts the casual tourist's activities towards Tibet, is another group of 21,000 foot peaks, nameless alike on the map and in the villages at their base, and just across the border is the magnificent pyramid of Lio Porguil in the Zanskar Range. It is interesting to record in these days of Himalayan Club activities that so far back as 1818 two hardy Aberdonians, Gerard by name, climbed to 19,000 feet on Lio Porguil. The Gerards' account of their excursions to the various passes to ascertain the height of the permanent snow level, is the first British travellers' version of Kanawar. Other interesting accounts were given by Thomson, the botanist, in 1858, and by Wilson in his "Abode of Snows" in 1875. The first forest record is a report by Brandis and Stewart in 1864, and about this time the forests were leased by the Punjab Government at the request of the then Raja, who found that his forests were rapidly disappearing under the attentions of get-rich-quick timber traders. The lease has recently been renewed for a further 25 years and under the new conditions the Raja receives a very handsome annual payment.

The forests of the Sutlej valley vary greatly in composition with alteration in rainfall, elevation, and aspect. In the monsoon zone the right bank (Pandrabis) has a great belt of the kharsu oak *(Quercus semecarpifolia)* running along below the open alpine pasture lands and below the oak a middle zone of blue pine (*Pinus excelsa)* and scattered deodar,. with lower still chil pine *(Pinus*

longifolia) and great open expanses of dry hot screes and cliffs reaching down to the river. The valuable deodar and kail forests of Pandrabis are to be found in the basins of the innumerable side-streams which run down from the Kulu boundary, and in these wild and isolated glens the vegetation is much more luxuriant and varied than in the barren reaches of the main valley.

As the Sutlej runs approximately east and west through Kanawar, the right bank is much more barren and deserted than the cooler northern aspects of the left bank, and on the left bank the zones of vegetation go much lower. Here the kharsu oak is not so much in evidence, and the higher forests are of spruce and silver fir, with kail and deodar below. The chil pine fades out a few miles above Wangtu bridge and its place is taken by the "neoza" (*Pinus Gerardiana*), the source of the edible "chilgoza" nut. The neoza and the holly oak (*Quercus Ilex*) form the lower forest belt throughout the farther ranges on the left Sutlej bank and also along the Baspa valley, which divides the Dhauladhar from the Great Himalayan Range. Above this belt the deodar continues to flourish, although the kail drops out of this middle elevational belt as the rainfall decreases, and is relegated to the higher zone where the long-lying winter snow provides subsoil moisture as a substitute for summer rain. The spruce and silver fir also drop out and deodar is left as the sole survivor of the larger conifers. Its optimum altitude increases with the increased aridity until in the Teedong valley and beyond Pu it only occurs on the more sheltered aspects at 9,500 to 10,000 feet. On the right bank beyond Chini the deodar persists along the main valley slopes, but in a very debased form with poor height growth, and it reaches commercial size only in some of the side valleys where it again develops into lofty forests on the more favoured aspects.

The Neoza—Ilex zone corresponds with the area in which the vine was at one time greatly cultivated, but this has died out owing to disease. The neoza is found forming pure forest in some of the farther side-streams, such as the Ropa Gad, which runs up to the Manirang Pass route into Spiti, but as one reaches further into the arid zone of the Tibetan border land, more and

more of the hill slopes are taken up with interminable stretches of the grey shrub *Artemisia maritima* and the greener but equally bleak horse-tail, *Ephedra intermedia.*

Deodar is of course the chief commercial timber, and throughout the very extensive belt which it occupies, the accompanying flora changes much more rapidly than do the habit and requirements of the deodar itself. The present Working Plan written by Messrs. Hart and Gibson in 1904 prescribed selection working with only an indication of the development which has since taken place in applying a more intensive type of regular working to all the better-class stands on comparatively easy ground. The output at present amounts to about 3 lakhs cubic feet of sawn timber per annum mostly in the form of railway sleepers, the timber being worked in the forest by sawyers imported from the lower hills. The local labour will not do sawing work, and the logging of round timber has been restricted to quite a minor place in recent years. All timber is sent down to the plains depots by floating in the Sutlej river, which provides its own peculiar problem in the Khatolu rapids, past which timber can be taken without damage only at very restricted periods when the summer floods have partially subsided.

Geologically the Sutlej valley is very interesting, and it was one of the earliest hunting grounds of Himalayan workers. The central granitic core of the hills is very well exposed at Wangto, and most of the forest soils are derived directly from granite and gneissose rocks. Towards the Tibetan border and beyond a line roughly indicated by the Teedong Gad and Jangi on the Hindustan-Tibet road, the hills are composed of sedimentary rocks belonging to the Silurian and Carboniferous strata of Spiti and Zanskar.

There is a wide variety of sport available to the tourist, though seldom unfortunately to the forest officer, whose nose is kept hard down on the grindstone of departmental timber work! Of birds there are the usual varieties of hill pheasant and "chikor", and "ramchikor" in the alpine zone. Goral are found in most nala bottoms and tahr on many of the precipices. Burrhel are found on both sides of the Sutlej though nowhere attaining any

great size, and ibex is confined to the Spiti watershed and is of the smaller Cis-Himalayan type, unless beyond Pu where the larger Tibetan type is to be found. Both black and red bear used to be plentiful but since the terrible storm of September 1924 they have been very much reduced in number, whether through disease or due to a disgruntled exodus to the arid inner hills I do not know.

For shikar trips probably the head of the Baspa adjoining Garhwal or any of the further nalas on the Spiti border are the best. The well known Bhabba nala above Wangtu is frequently shot over by sportsmen on their way over the Bhabba Pass in to Spiti, where ibex is more plentiful than on the Sutlej side. The control of shooting has recently been handed over entirely to the Raja of Bashahr under the new lease and as the village shikari is already agressively active, the prospects of any game surviving the next few years is distinctly poor. Already the much prized musk deer's pod is being accepted by the State in payment for village shikaris' licenses, and it is hardly to be expected that the dainty little "mushknafa" can long avoid complete extinction.

Of fishing there is none in the sporting sense of the word for the Sutlej is too depressingly cold and muddy for anything but mudfish to frequent, nor do I know of any fishing to be had in the side-streams, most of which descend in a series of cataracts from the glaciers and snow fields above. For a pleasure trip without any very definite object, however, the Hindustan-Tibet road forms an easy means of reaching the inner hills in comparative comfort, and the scenery, particulary within sight of the Kanawar Kailas, is really magnificent. Mules should be arranged for in Simla for the whole journey and a light tent is advisable unless one is to be tied down to using the stage bungalows.

R. MACLAGAN GORRIE, I. F. S.

(NOTE ON THE GAME ANIMALS OF BASHAHR BY H. M. G.)

Mr. Gorrie laments the lack of opportunity for shooting enjoyed by the Forest Officer. The game is there all right, but

frequents remote nullahs and the heights, is not plentiful, can only be shot with difficulty and opportunity rarely offers in the course of one's ordinary work. But I remember red letter days stolen for sport when one arrived back tired and weary but very happy after a successful stalk near the everlasting snows sometimes with a good trophy but more often without.

Ibex only exist on the Spiti watershed in a few nullahs and never cross the Sutlej river and the best ibex I shot in the eight years I was in Bashahr measured 42½" and was the biggest I heard of. Burrhel are more plentiful but I never secured a really big head; tahr are badly poached and live in the most inaccessible precipices, black bear are common outside the dry zone but the forests are so extensive that they cannot be driven; red bear are rare, leopard follow the flocks and do much damage but are rarely shot. The only ordinary leopard I killed was with a charge of No. 3 shot when after pheasants, but I was lucky enough to shoot a snow leopard which had killed a goat in the early afternoon close to my camp towards the Tibetan border. Goral are fairly common outside the dry zone, barking deer are rare and are never found in the dry zone, musk deer are badly poached.

In 1919 there was exceptionally heavy snow-fall and the game was driven and slaughtered throughout Lower Bashahr, tahr, goral, barking deer and musk deer suffering severely, the slaughter ceasing only when three men were swept away by an avalanche. In spite of poaching game animals survive but never in large numbers and a trip to Bashahr is not likely to yield the large bags that the tourist shikari longs for, but may yield good individual trophies. The shooting rules are strict and the animals allowed to be shot are limited. The bird shooting is excellent, and that at least the average Forest Officer does full justice to, but limits his bag when the larder is full. One shoots for the pot and gets monal, tragopan, chir, koklas and kalij pheasants and as many chikor as one desires but has to work hard for one's game. An autumn day's chikor shooting with pleasant campany is the most enjoyable sport in the world, enjoyed under ideal conditions, and many are the enjoyable hours I have spent after this sporting bird.

THE INDIAN BAMBOOS BROUGHT UP-TO-DATE.

BY E. BLATTER, S.J., Ph.D., F.L.S.

It is over thirty years ago that the late Mr. J. S. Gamble after a lifetime of intensive experience in the Imperial Forest Service gave us his excellent Monograph of the Indian Bamboos (Annals Roy. Bot. Gard. Calcutta, VII, 1896). Since then some of his species have been revised and, as knowledge increased, some of his doubtful ones reduced. To the old stock quite a number of new species have been added either by Gamble himself or by other workers in the field.

It is always difficult for the botanist in India to get access to the scattered literature on any particular subject, even if he be fortunate enough to live in the neighbourhood of one of the few extensive botanical institutions. I don't think I am exaggerating by saying that there is still a vast field for research for the forester as well as for the pure botanist before the many important and intricate problems in connection with the bamboo forests of India are brought nearer their solution. Everybody will admit that the exact systematic study of any group of plants is the necessary foundation of other fruitful work. So many observations, quite interesting in themselves, are rendered useless for the formation of conclusions and the solution of general problems, simply on account of the doubtful identity of the plant observed.

The following data have been put together with the intention of facilitating the efforts of the systematist and, at the same time, to draw the forester's attention to the many doubtful species which he can help to make better known. It is nearly always the flower that is required for assigning a bamboo to the right genus. Many attempts, even of prominent botanists, at classifying bamboos without flowers, have failed.

With regard to the arrangement of the matter I have followed Gamble's Monograph. The reference to it is given in brackets after each species.

At the end is added a list of books consulted, the authors being arranged in chronological order.

ARUNDINARIA Mich.

Arundinaria Walkeriana Munro (Gamble Ind. Bambus. 3).—The synonym *A. Wightiana* Thw. is doubtful because put under *A. Walkeriana* by some (Camus, etc.) and under *A. Wightiana* by others (Gamble).

Exclude Beddome's specimens with leaves only collected in the Pulney Hills, because doubtful.

Arundinaria Wightiana Nees (Gamble Ind. Bambus.4).—Exclude *A. Wightiana* Thw. Enum. Pl. Zeyl. 444.

Arundinaria elegans Kurz (Gamble Ind. Bambus. 6).—Exclude Anderson's and Gallatly's specimens included by Gamble. He says himself "both these (specimens) have the leaflets in pairs, supported by loose sheaths and the culms markedly flat on one side, which would seem to bring them nearer to *Phyllostachys*." As a matter of fact Brandis felt inclined to refer Anderson's specimen to *Phyllostachys Mannii* Gamble.

Arundinaria racemosa Munro (Gamble Ind. Bambus. 9) has been split up by Gamble into two species:

Arundinaria racemosa Munro in Trans. Linn. Soc. XXVI (1868) 17, *emendata a Gambleo* in Kew Bull. (1912) 138; Gamble in Ann. R. Bot. Gard Calc. VII (1896) 9 (*partim*), t. 8. figs. 2, 5-13, in Hook. f, Fl. Brit; Ind. VII, 379 (*partim*); Brandis Ind. Trees (1911) 664 (high-level form).—*A. Gammieana* Gamble M. S. (ex Gamble).

A small species; subterranean rhizome scarcely 5 mm. thick, sending up slender culms at intervals; leaf and flower-bearing branchlets fascicled at the nodes. Culms erect, 0.6-1.2 m. high; internodes yellow, up to 10 cm. long, 1 cm. diam., terete, not scabrous. Culm-sheaths straw-coloured, glabrous or sparingly pubescent towards the apex, 6-10 cm. long, 1.5—2 cm. broad, striate, at the mouth sparingly ciliate and sometimes horned, lamina narrowly subulate, 0.5—1.5 cm. long, scabrous; branchlets terete, glabrous, rufescent, often geniculate. Leaves thin, linear-lanceolate, at the apex setaceous-acuminate, obtuse at the base or attenuate into a short broad petiole, 3-10 cm. long, 5-10 mm. broad, nerves 3 pairs, intermediate 5-7, transverse veinlets conspicuous, about 5-6 per mm.; the younger leaves with long

hairs beneath, then glabrous, on one edge smooth, on the other scabrous; sheath striate, first pubescent, afterwards glabrous, ending in a short membrane, or horned and fimbriate with a few long bristles; ligule short, puberulous. Pancile simple, racemose, supported at the base and sometimes almost up to the spikelets by long, striate, sheathing bracts; rhachis glabrous; spikelets 3-6, 3-5 cm. long, pedicels angular, filiform, 1-3 cm. long; spikelets 4-6-flowered, distichous, alternate, the uppermost flower sometimes empty; rhachilla clavate, pubescent, 5-6 mm. long. Glumes I and II (empty) very variable, small, acuminate, 2-3.5 mm. long, distant; glume III (flowering) ovate-acuminate, pubescent, scabrid-aristate, with 7-9 conspicuous nerves, 9-10 mm. long; IV (pale) almost as long as III or shorter, bimucronate at the apex, keels towards the apex (outside) ciliate, nerves obscure. Lodicules 3, ovate-lanceolate, ciliate, nerved at the base, 1-5—2 mm. long. Anthers purple, 5 mm. long, bifid at apex. Ovary ovoid; style short; stigmas 3, short, papillose. Caryopsis oblong, attenuate at apex, furrowed longitudinally.

Distribution: Eastern Nepal: Yalloong, 10,000 ft. Sikkim: Woods above Islumbo Pass; Singalilah, 10,000 ft.; Saburkum 10,000 ft.; Phalut, 10,000 ft.; Jongri, 12,000 ft. (ex Gamble).

This is the high-level form of the original *A. racemosa*, growing at altitudes from 10,000—12,000 ft.

The low-level form has been described under the new name of—

Arundinaria Maling Gamble in Kew. Bull. (1912) 139.

An erect shrub, 3-9 m. high; rhizome stout, subterraneous, producing single culms at intervals. Culms slender, erect, fistular, walls 5 mm. thick, internodes scabrous above, 30-40 cm. long, 2-3 cm. diam; culm-sheaths straw-coloured, chartaceous-coriaceous, exceedingly striate, sparingly fulvo-hispid, with cilliate margins, up to 30 cm. long and 10 cm. broad, attenuate above, mouth 1-2 cm. broad, auriculate, provided with long, rigid, patent bristles; blade subulate, 6-7 cm. long, erect or reflexed, scabrous inside; ligule 1 cm. long, much fimbriate. Leaves chartaceous, linear-lanceolate, setaceous-acuminate at the apex, attenuate into a short petiole, glabrous on both sides, glaucescent beneath, margins minutely scabrous; 5-18 cm. long, 0.8—2 cm. broad; nerves 3 pairs, intermediate nerves about 6-9 (5-6 per mm.), transverse veintles

conspicuous, tessellate, about 3-4 per mm.; sheaths striate, the ciliate mouth excepted glabrous and here provided with a few long, rigid bristles; ligule short, truncate, pubescent. Panicle decompound, 10 cm. long, provided at the base with spathaceous and higher up with foliaceous sheathing bracts; rhachis glabrous angular; branches and pedicels filiform, sinuate, 1-2 cm. long, spikelets 10-20, 3·5 cm. long, 7-9-flowered, alternate, the uppermost empty; rhachilla clavate, curvate, complanate inside, pubescent, ciliate, 5-6 mm. long. Glumes I and II (empty) embracing the lowest flower, ovate, scabrously setaceous-acuminate, I nerveless, 2-4 mm. long, II 5-nerved, 7-9 mm. long; glume III (flowering) ovate, scabrously setaceous-acuminate, 7-9-nerved with transverse veinlets, 1-1·2 cm. long; IV (pale) bifid at apex, keels ciliate, between the keels 2-3-nerved with a few transverse veinlets, at the sides 1-2-nerved, 7-8 mm. long. Lodicules 3, ovate; obtusely acute, ciliate, nerved at the base, 2-2·5 mm. long. Anthers yellow, 5-6 mm. long, bifid at apex. Ovary ovoid; style short, slender; stigmas 3, long, plumose. Caryopsis unknown.

Distribution:—Sikkim: Mount Tonglo, 9,000 ft.; Mainom, 8,000 ft.; at various other places in British Sikkim (ex Gamble).

A. Maling is nearly related to *A. Pantlingi*, but Gamble points out that the latter species has long loose much-branched panicles, longer and narrower spikelets, glumes with more conspicuous awns and strongly ciliate leaf-sheaths, while in *A. Maling* the panicles are quite short and compact, the spikelets broad, the glumes less awned and the leaf sheaths glabrous at the margins."

E. G. Camus in Les Bambusées (1913) 31 has adopted Gamble's new name: *A. Maling* and gives as synonym *A. racemosa* Munro in Trans. Linn. Soc. XXVI, 17, Gamble Ind. Bambus 9 and in Hook. f. Fl. Brit. Ind. VII, 379, Brandis Ind. Trees 664. The description is entirely and exclusively the one which Gamble gives of his *A. Maling* and which shows to evidence that this new species is quite distinct from *A. racemosa* Munro as amended by Gamble.

If it was Camus's intention to unite *A. racemosa* Munro (*non emendata*) with *A. Maling*, it was certainly not correct to give only the characters of the latter species. • • •

Arundinaria falcata Nees (Gamble Ind. Bambus. 12).— Exclude *A. utilis* Clegh. in Journ. Agr. Soc. Ind. 12 (1865) 388 Gamble himself says referring to Cleghorn's 'Notes on the vegetation of the Sutlej Valley': "There is no description, and though Munro and Brandis have quoted it in their list of synonyms, the 'hill bamboo at 9,000 ft., used for wicker work and for lining the roofs of houses' is just as likely to have been *A. spathiflora*." Include under synonyms: *Ludolfia falcata* Nees ex Munro Trans. Linn. Soc. 26 (1868) 26; *Thamnocalamus Ringala* Falc. ex Munro l. c. 157.—There seems to be a doubt about the number of stigmas: Nees saw 3, Ruprecht 2-3, Munro, Gamble, Brandis and Camus 2.—2 good plates in Kew Bull, (1921), p. 304, 305.

Arundinaria khasiana Munro (Gamble Ind. Bambus. 14).— About this Gamble says: "It is most difficult to separate this from *A. falcata*; but......it has a different look, and it is a plant of a stiffer and stronger general growth......*A. khasiana* has a more dense and imbricated panicle, shorter flowers and a hairy rachis to the spikelet." Brandis adds that *A. khasiana* is similar to *A. falcata*, "but the stems stronger and harder, leaves broader, transverse veinlets often faintly visible, nerves 27-42 on ¼ in., inflorescence more dense."

'A stiffer and stronger general growth' cannot be a specific character and may be due to different edaphic and climatic conditions.

It is well known that *A. falcata*, measuring in India 1·8-3 m. in height, reaches in cultivation more than double that size. We may be allowed to add a few differences between the two species which might be more satisfactory.

	A. falcata	*A. khasiana*
Spikelets	2-4-flowered	2-3-flowered.
Lower empty glume	1-3-5-nerved	3-nerved.
Upper empty glume	7-nerved	5-7-9 nerved.

Arundinaria aristata Gamble (Gamble Ind. Bambus. 18) has been transferred by Camus to *Thamnocalamus* under the name

T. aristatus E. G. Camus Bambusées (1913) 54. In the same way.

Arundinaria Prainii Gamble (Gamble Ind. Bambus. 21) is called by Camus *Thamnocalamus Prainii* E. G. Camus l. c. 54 pl. 25, f. B. Camus has separated sect. III and IV of Gamble's Indian Bambuseæ p. 3 and in this he followed Munro, at least as far as sect. III is concerned. We have no good reason for making this separation and so we leave *Thamnocalamus* under *Arundinaria.*

Gamble was quite right by not agreeing with Oliver in referring his *A. Prainii* to *A. kurilensis* Ruprecht in Bull. Phys. Math. Petersb. VIII (1850) 121. The latter has been transferred to the almost exclusively Japanese genus *Sasa* under the name of *Sasa kurilensis* Makino & Shibata in Bot. Magaz. Tokyo XV (1901), after it had been named *Bambusa kurilensis* Hackel in Bull. Herb. Boiss. VII (1899) 719. It had even been called *Arundo donax* by Georgi in his Beschr. Russ. Reich. III, IV, 705.

Arundinaria Falooneri Benth. & Hook. f. (Gamble Ind. Bambus. 20).—Add synonym: *A. falcata* Rivière in Bull. Soc. Acclim. sér. III, V, 791.—There is a good plate by Stapf in Bot. Magaz. t. 7947.—Perhaps the following belongs here: *A. nobilis* Freeman-Mitford Bamboo Garden (1896) 178.

Arundinaria gracilis Blanchard in Revue Horticole (1886) 490; Houzeau de Lehaie Le Bambou nos. 9-10, pl. XVII; E. G. Camus Bambusées (1913) 38.—*Bambusa gracilis* Hort. ex A. & C. Riviére in Bull. Soc. Acclim. sér. III, V (1878) 682.

A small cespitose bamboo. Culm-bud provided with slightly coloured sheaths. Culms flexible, intensely glaucous, almost silvery; lower culm-sheaths much narrowed at the apex, without imperfect limb and ligule, the upper ones provided with an imperfect limb, reaching 12-15 cm., insensibly narrowed into a point. Culms attaining 4-5 m., 2 cm. diam., at first green, then brown; producing in the middle part numerous fasciculate branches which appear to be semi-verticillate. Leaves bright green as is the sheath; ligule membranous, dry; limb 9-10 cm. long, 8-10 mm. broad, attenuate at the base into a petiole, acuminate at the apex.

Inflorescence divaricate, composed of spikelets which are supported by pedicels rising from the nodosities of the branches and provided with 1 or several bracts which are membranous, acute at the apex and longitudinally striate. Spikelets compressed, 2- *(rarely 3-)* flowered. Empty glumes small, concave, lanceolate-the uppermost smaller and shorter than the lower. Flowering glumes almost equal, many-nerved, violet, concave, muticous. Lodicules 3, small, rounded, scarious, ciliate at the apex. Stamens, 3; filaments long, pendulous. Ovary surmounted by 2 plumose stigmas. Caryopsis ovoid, oblong, acuminate at the apex.

This species has been included on the authority of E. G. Camus. It is quite unknown to us.

Distribution :—" Japon Spont.? ; Himalaya" (Camus).

This plant has not been mentioned by any author writing on Indian bamboos. It is said to have been introduced into Europe by Mr. Cloquet in 1865. Cultivated by Count Boromée on the Lago Maggiore.

SPECIES DUBIÆ.

Arundinaria Mannii Gamble (Gamble Ind. Bambus. 26). It was placed by Gamble under *Arundinaria* "on account of its resemblance generally to *A. Prainii*, especially in the solid culms." This cannot be a sufficient reason, especially when immediately after the author adds: "in its leaves it resembles *Cephalostachyum*."

Arundinaria Clarkei Gamble ex Brandis Ind. Trees (1911) 666; Camus Bambusées (1913) 49. A slight shrub, 3 m. high. Leaves 10-17 by 1·2-2 cm., nerves 28-33 on $\frac{1}{4}$ in. Stamens 6.—Belongs to section IV of Gamble.

Loc. :—Manipur.

Arundinaria sp., near *A. elegans* Kurz.

Vern. name :—Lading wa. Brandis Ind. Trees (1911) 667.

Single-stemmed, erect; culms 6·3 m. high, 2-4 cm. diam. nearly solid. Leaves 10-12·5 by 1·2 cm., finely hairy on the underside, nerves 27-42 on $\frac{1}{4}$ in., transverse veins mostly close, forming short rectangles and squares with longitudinal nerves,

Loc.:—Burma: Hills east of Bhamo, 6,500 ft.

Arundinaria Phar E. G. Camus. Bambusées (1913) 37; Brandis Ind. Trees (1911) 721.

Vern. name :—Phar.

A thorny bamboo. Internodes 7·5-15 cm., 4-5 cm. diam. walls thick; at each node a ring of numerous sharp thorns, up to 25, slightly bent downwards, mostly 6, some 20 mm. long. Culm-sheaths membranous, longer than the internodes, densely clothed with dark brown hairs, the thorns piercing the sheath; blade triangular. Leaves 15 by 1·2-2 cm., 22 nerves on $\frac{1}{4}$ in., transverse veins conspicuous.

Loc.:—On the Hmin-Fang range, Lushai hills.

Arundinaria anceps Freeman-Mitford Bamboo Garden (1896) 181.—*A. spathiflora* Trin.? Kew, ex Houzeau de Lehaie Le Bamboo, juillet 1906.

This species is mentioned by E. G. Camus Les Bambusées (1913) 33 as occurring in "Nord Est de l' Inde, Garhwal Britannique" (sic!) Said to be cultivated especially in England at Kew, etc.

The flowers are not described. Camus says that it is nearly related to *A. nitida* Mitford, "mais" he adds "cette espèce est d'un pourpre plus foncé dans toutes ses parties, et elle est dépourvue de la ligne de poils de la gorge des gaines." It has not been mentioned by Gamble and Brandis and has not been included in the Index Kewensis.

Gamble, when referring to *Arundinaria jaunsarensis* Gamble (Kew Bull. 1921, p. 803) adds: "I am strongly of opinion that it is the same as the well-known *A. anceps*, Freeman-Mitford, which is hardy in this country and flowered in 1910 in the garden of Mr. C. H. Cave at Mangotsfield near Bristol. Lord Redesdale, in the "Bamboo Garden," p. 181, says that "it was picked up at the sale of a dead nurseryman's effects by Mr. Jordan, the Superintendent of Regent's Park, who very wisely bought the whole stock." He gives no date, however. Mr. Bean's account of it is different; he says: "introduced by Col. Edmund Smyth

from Garhwal about 1865 and first cultivated at Elkington Hall, Lincolnshire." I have also another account of its origin from the late Mr. T. W. Webber, who was in the sixties of last century a forest officer in Kumaon and whose book "The Forests of Upper India," published in 1902, is an interesting account of work, travel and sport in the Himalaya and Central India at that time. Mr. Webber wrote in May 1907 to Mr. J. W. Oliver, who sent his letter on to me some years later as follows: "The straight, upright *Arundinaria anceps* (so named at Kew) which I sent you was from seed which I procured myself in Kumaon high up, and it has been growing in the garden here (Athy, Ireland) for 25 years. There is a clump 30 yards round. It sends out lateral suckers and spreads itself rapidly. "Mr. Webber, with whom I had already got into communication myself in 1907, sent me specimens of the culms, culm-sheaths and leaves from his clump, and they were undoubtedly *A. anceps*. Mr. Webber was in Kumaon from 1861 to 1864, in which latter year it is probable that the bamboo flowered and seeded, and that Mr. Webber and others collected the seed and distributed it. I think it may be useful to put this information on record. Though I myself believe that the Kumaon *A. anceps* and the Jaunsar *A. jaunsarensis* are the same, we can not be quite sure until flowers of the latter are available."

PHYLLOSTACHYS SIEB. & ZUCC.

Phyllostachys assamica Gamble in Brandis Ind. Trees (1911) 667; Camus Bambusées (1913) 65.

Culms 3-3·3 m. high; culm-sheaths straw colour, at the base of the narrow blade with narrow oblong auricles covered with long bristles, transverse veins prominent on the inside of culm-sheaths. Leaves thin, linear-lanceolate, 10-15 by 1·2-2 cm., petiole slender, 5 mm. long, nerves 36-42 on ¼ in., leaf-sheaths long bristly-ciliate at mouth. Fl. unknown.

Loc.: Mishmi hills, forming extensive patches covering the hill-side; Namdang, Lakhimpur Dist., Sadiya: also cultivated near Sibsagar (ex Brandis).

The material from the Mishmi hills was identified by Munro as *Phyllostachys bambusoides* Sieb. & Zucc. and Gamble followed

him in the Indian Bambuseæ. Later on, however, Gamble came to the conclusion that the Assam material forms a separate species and is distinct from the Chinese *P. bambusoides.* As Gamble prepared his plate No. 27 from a Hongkong specimen, it does not represent *P. assamica.* Also his description and synonymy refer to the Chinese species (see next species).

Phyllostachys bambusoides Sieb. & Zucc. in Abh. Akad. d. Wiss. Münch. III (1843) 745, t. 5, f. 3; Munro in Trans. Linn. Soc. 24 (1866) 36 (*partim*); Houzeau de Lehaie in Act. Congrès Intern. Bruxelles II (1910) pl. XLVIII, XLIX, LI, Le Bamboo, Nos. 9-10, pl. XIX, XX; Gamble Ind. Bambus. (1896) 27, pl. 27 (*partim*), in Hook. f. Fl. Brit. Ind. VII, 386 (*partim*); E. G. Camus Bambusées (1913) 56; *non* Miquel Prolusio Fl. Jap. in Ann. Mus. Bot. Lugduno-Batav. *et auct. plur.*—*P. macrantha* Sieb. & Zucc. in Flora (1846) 34.—*P. Quilioi* A. *et* C. Rivière Les Bamboos 241, f. 25-27.—*P. Mazeli* Hort. ex A. *et* C. Rivière l. c. —*Bambusa reticulata* var. *macrophylla* Rupr. Bamb. 58; Koch Dendrol. II, 358; Makino in Bot. Mag. Tokyo XXVI, 19, f. VI. —*B. Quilioi* Hort. ex Rivière.—*B. Duquilioi* Hort.

Gamble's synonymy requires several corrections: Franch. *et* Savatier *Enum. plant. in Japonia sponte cresc.* 182. There is a note in that volume to this effect: "Dr. Savatier has repeatedly observed this species about Yokoska, where it seems to grow spontaneously; it must flower rarely in this station......The leaves are often bordered with a large yellow band; they are found mixed with others quite green on the same branches; the var. β *albomarginata* Miq. need not, therefore, be retained." It is evident that the authors had not before them specimens of *P. bambusoides* Sieb. & Zucc. Perhaps their plant belonged to *Sasa paniculata* M. & S.—As to *P. megastachya* Steud. Syn. 339, Houzeau de Lehaie who has seen Steudel's specimen identifies it with *P. pubescens* H. de L.—Regarding *B. reticulata* Rupr., the diagnosis does not fit in at all.—*Bambusa bifolia* Sieb. Ms. (*teste* Munro), is *P. pubescens* H. de L.

Description: Arborescent, 9-27 m. high, stump long-creeping, 10-30 mm. thick with short internodes; culm-bud stout, dull black;

culm erect, shining green, furrowed on one side, rarely attaining 20 cm. diam., sometimes a little thicker at a height of some m. than at the base, with long internodes, glabrous, polished, sometimes yellowish in the sun, with a waxy ring below the node which disappears with age; culm-sheath extremely variable, covered on the back with black hairs, 3-5 mm. long, first appressed but soon erect, caducous; limb imperfect, papyraceous, first erect, then bending over, striate, with the median stria dark green, and the lateral pale rose, provided or not with small auricles; ligule small, laciniate; scale 2-keeled, papyraceous, bifid at apex, lobes acute, spotted with brown, glabrous, keels ciliate. Branches effuse cylindric, canaliculate, fistular, shining green; branchlets about 2 mm. thick. Leaves 10-11·2 cm. by 12-17 mm. arcuate, broadly linear, attenuate at the base into a short petiole, suddenly and long-acuminate-setaceous at the apex; secondary nerves 5-7 pairs, tertiary 8-9 between the secondary ones, 30-37 on $\frac{1}{5}$ in., transverse, veins 30-35 on $\frac{1}{5}$ in.; teeth 9-10. Inflorescence consisting of multispiculate lanceolate spikes, 40 by 10-15 mm. long; bracts ciliate near the mouth, limb imperfect, foliaceous, large, ovate-lanceolate, cordate, 35-20 mm., smaller in the upper bracts. Spikelets 20-25 mm.; fertile flowers 3-5, terminal flower imperfect; flower greenish or rufescent; glume 1, often terminated by a very small imperfect limb, oblique, carinate with ciliate keels, subnerved-longer and more oblique in the upper spikelets, sometimes absent in the terminal ones; lower floral glume ovate-acuminate, secondary nerves 5-6 pairs, upper as big as the lower, scabrous, pubescent, 2-keeled, 2-mucronate at the apex. Lodicules ovate-lanceolate emarginate or bifid, ciliate, 3-7-nerved. Stamens with long filaments, 4-4·5 cm. Ovary ovoid, stipitate; styles 2·5-3 cm., connate; stigmas plumose. Caryopsis unknown.

A short comparison of the above description with that given by Gamble (Ind. Bambus. 27) shows considerable differences and it becomes evident that, when Gamble described the vegetative organs of *P. bambusoides*, the specimen before him was not a *P. bambusoides*, not even a *Phyllostachys.* For the diagnosis of the floral organs he used a true *Phyllostachys* and this time the real *P. bambusoides*, because he says: "Ovary depressed, ovoid

glabrous, stalked at the base." All the other characters mentioned by him are common to the two species *P. bambusoides* Sieb. & Zucc. and *P. pubescens* H. de L.

If we examine Gamble's plate 27 we have to consider what he says on p. 27: "Munro has identified Griffith's plant with the well-known China and Japan species, but apparently no flowers have been seen. I have consequently taken my plate from a Hong-Kong specimen in the Calcutta herbarium." Gamble, therefore, has united under one and the same name and in the same description a specimen without flowers gathered by Griffith in the Mishmi Hills and a flowering specimen collected in Hong-Kong. The first is an unknown bamboo, the second the true *P. bambusoides.*

Distribution: A native of Central China.—Cultivated in India, Indo-China, and Europe (Camus).

Phyllostachys puberula Makino in Bot. Mag. Tokyo (1900) 64, Houzeau de Lehaie in Act. Congr. Int. Bruxelles (1910) t. LII, LIII, LIX; E. G. Camus Bambusées (1913) 57.—*Bambusa puberula* Miq. Prolus. fl. Jap. (1865) 173.—*Phyllostachys Henonis* Freeman Mitford Bamboo Gard. 149; Stapf in Hook. Ic. Pl. t. 2614; Pilger in Jahrb. XXIX (1900) 227.—*P. nigra* var. *Henonis* Rendle in Journ. Linn. Soc. 36 (1904) 443.—*Bambusa Henonis* Hort. ex Bean.

A shrubby or arborescent bamboo, 3-24 m. high. Stump 10-30 mm. diam. Culm-bud grey or reddish. Culm usually furrowed on two opposite sides, showing in the branching part on one side a double or triple furrow, on the other one weak furrow. Culm-sheaths more or less coriaceous, variable, covering at least half of the internode, 30-50 cm. long, darker at the top, slightly spotted, finely pubescent with interspersed long hairs; limb imperfect, 10-15 cm. long, 10-15 mm. broad, linear-undulate, puberulous on both sides, provided or not with 2 small long-ciliate auricles; ligule rather short, fimbriate. Scale 2-keeled, bifid almost to the base, with unequal, obtuse, straight, transparent lobes. Big branches not fistular, with 3 or 4 sides convex, plane or furrowed. Branchlets

very thin, 1 mm. diam. or more, bearing 2-3 leaves. Leaves 6-10 mm. long, about 1 mm. broad, sometimes larger, narrowly lanceolate-acuminate, attenuate into a long point, median nerve puberulous and prominent below, secondary nerves 4-5 pairs, intermediary nerves 5-9 pairs, tesselate; petiole short; sheath striate, slightly puberulous on the edges, mouth with straight caducous hairs; ligule 1-2 mm. long, shortly fimbriate. Inflorescence an ample panicle, composed of spikes which are first lanceolate and later on subglobose, comprising numerous spikelets; bracts with an imperfect rounded limb, but not cordate at the base, enveloping a group of 2-5 spikelets. Spikelets with 1-2, rarely 4 hermaphrodite flowers and 1 rudimentary large one at the top. Empty glumes rarely absent, puberulous on the back and at the tip, glabrous towards the base, the upper one the largest 9-12 mm. 3-7 nerved. Lower flowering glume with the median nerve prominent, with 9-11 more or less anastomosing nerves, scabrous on the nerves and on the intervals, upper slightly bifid 2-carinate, 2-cuspidate, 2-keeled at the apex, slightly scabrous on the back and the keels, transparent, the nerves not very distinct. Lodicules yellowish, obscurely 3-nerved. Filaments 3 times as long as the anther which is 8-10 mm. long and pendulous. Ovary ovate-acuminate, style long, crowned with 3 stigmas. Caryopses not numerous, with a shallow furrow.

Native country: Central China and Japan.

Var. *nigra* Houzeau de Lehaie l.c.; E. G. Camus l.c. 59.—*Phyllostachys nigra* Munro in Trans. Soc. 25 (1866) 38; A. and C. Rivière Les Bamboos 255, f. 33-35.—*Bambusa nigra* Loddiges Cat. (1823) ex Loud. Hort. Brit. 124.—*Arundinaria stolonifera* Kurz Cat. Hort. Bot. Calc. 79.—*Arundarbor nigra* Rumph.—*Bambusa nigricans* Hort. ex Steud. Nom. ed. II, 183 (ex Rivière).—*B. dichotoma* Donn. Hort. Cant. ed. IV, 78.

Culm 4·5-7 m. high, first green, soon passing into a more or less deep and shining black, the small branches less uniformly black. Leaves membranous, less long-acuminate.

Vern name: Kurodake (Jap.).

Cultivated in the Indian hills (Gamble) and Europe (Camus).

Species Dubiae.

Phyllostachys Sedan E. G. Camus Bambusées (1913) 66; Brandis Ind. Trees (1911) 667.

Vern. name: Sedan (Burm.) Brandis.

A small bamboo; internodes 20 cm. long, 16 mm. diam., stems flat on one side. Some of the leaves in pairs; petiole slender, 6 mm. long, nerves 39-42 on ¼ in.—According to Brandis similar to *Phyllostachys Mannii* Gamble and perhaps identical with it.

Loc.: Hills east of Bhamo 6,500 ft.

Phyllostachys Bawa E. G. Camus Bambusées (1913) 66.—P. No. 4 in Brandis Ind. Trees (1911) 719.

Vern names: Bawa (Burm.), Mepwe (Kar.).

Single-stemmed, but forming large dense patches. Culms 3·6-6 sometimes up to 9 m. Internodes 12·7-22·8 cm. long, 2-5 cm. diam. Leaves often apparently in pairs, 10-12·5 by 1·2 cm.; petiole slender, 1·2 cm. long, ligule with deciduous bristles, nerves 36-40 on ¼ in., transverse veins forming squares and rectangles with the nerves.

Loc.: Hills north of Papun, generally near streams (F. B. Manson).

BAMBUSA SCHREBER.

Bambusa nutans Wall. (Gamble Ind. Bambus. 32).—Exclude the specimens collected by Mann in Assam: Sibsagar. Kamrup N. Cachar, Shillong, identified by Gamble as *B. nutans.* It is surprising that he should include those specimens immediately after his statement: "This species is extremely difficult of separation from *B. Tulda* Roxb., when flowers are not available, the leaves and culm-sheaths agree very nearly, and it is only in flower or growing that the two can be distinguished." Gamble must have felt the incongruity of his procedure himself for, after including Mann's specimens he adds: "but I am by no means sure of the identification, as any of them might be *B. Tulda* instead, though they seem to me more like *B. nutans.*" I don't know how far Mann's gatherings have influenced Gamble's

distribution of the species. In any case it does not seem to serve any good purpose to include uncertain material.

Bambusa teres Ham. (Gamble Ind. Bambus 33).—Plate No. 31. Figures 3 and 7 from Mann's Bhaluki-makal may or may not be *B. teres.* Gamble himself was not sure as he says: "I also think that G. Mann's Bhaluki-makal (Assamese) collected in Sibsagar in 1889, is this species." Everybody is allowed to express his opinion on the identity of a certain specimen, but a figure drawn from an uncertain specimen should not be included in a plate figuring the type-specimen. This can only cause confusion.

Bambusa polymorpha Munro (Gamble Ind. Bambus. 36).—It is still doubtful whether the flowers are monoecious, dioecious or hermaphrodite. Munro and Camus say they are monoecious or dioecious, whilst Gamble calls them hermaphrodite. Is there a mistake somewhere about the identity of certain specimens?

Bambusa pallida Munro (Gamble Ind. Bambus. 37).—The synonym *Dendrocalamus criticus* Kurz For. Fl. Burma II, 559 should be provided with a sign of interrogation. Gamble says that in all probability this species is identical with *B. pallida.*

Bambusa khasiana Munro (Gamble Ind. Bambus. 39).—It is not satisfactory that the figures on pl. 37 in Gamble's Bambuseæ were drawn from different specimens. Fig. 1 represents a specimen gathered by Mann which, as Gamble says, "consists of leaves which agree in every respect with those of Hooker's specimens; and I have therefore no reason to doubt that they, with their extraordinary culm-sheaths, belong here." Why not draw the figure from Hooker's specimens, especially as they were available? Fig. 2 is said to have been taken from Hooker's and Mann's specimens. It represents part of a flowering panicle which does not exist in Mann's specimens, as he collected only leaves and culm-sheaths.

Bambusa nana Roxb. (Gamble Ind. Bambus. 40).—Add synonyms: *Bambusa glauca* Blume ex Rupr. in Mém. Acad. Petersb. sér. VI, V (1839) 162.—*B. floribunda* Zoll. and Mor. ex Steud. Syn. Pl. Gram. 330.—*B. aurea* Franchet *et* Savatier *non* A. and C. Rivière *nec* Sieb. (e Camus).

Bambusa vulgaris Schrad. (Gamble Ind. Bambus. 43).—Add synonym: *Nastus viviparus* Rasp. in Ann. Sc. Nat. sér. I, V (1825) 458 ; Houzeau de Lehaie Le Bambou No. 5-6, pl. 3.

Var. *striata Auct. mult.*—Add synonyms: *Bambusa striata* Loddiges ex Lindley Penny Cycl. III (1835) 357; Curtis Bot. Mag. 30 (1874) t. 6079.—Var. *vittata* A. and C. Rivière.—B. var. *culmis variegatis* Hort. Gall—B. variegata Hort.

Bambusa arundinacea Willd. (Gamble Ind. Bambus. 51).—Add synonym : *Nastus arundinaceus* Sm. in Rees Cycl. XXIV No. 1.

Bambusa auriculata Kurz (Gamble Ind. Bambus. 55). Unite with *Oxytenanthera nigro-ciliata* Munro. *B. auriculata* had been put by Munro under *Bambusa vulgaris.* Kurz in his Forest Flora places it in the genus *Gigantochloa* and finally it has landed under *Oxytenanthera.* This is an instructive example of how little vegetative organs alone can be relied upon.

Bambusa longispiculata Gamble ex Brandis Ind. Trees (1911) 668; E. G. Camus Bambusées (1913) 116.

Vern. names: Mitenga (Chitt.). Thaikwa (Burm.)

Tufted, culms 12 m. high, 7·6 cm. diam. Leaves 17·7-30 by 2·5-6·2 cm. with nerves 24-31 on $\frac{1}{4}$ in. Spikelets very long, up to 15 cm., slightly compressed, polished, in the axils of long coriaceous sheaths without a blade, in half whorls on erect often branching spikes 28-38 cm. long. Empty glumes 2, fertile 6-12, 2-5 cm. long.

Nearly related to *B. Tulda*, but differs chiefly by very long and slightly compressed spikelets (Brandis).

Loc.: Burma ; Chittagong hill tracts, Ruby Mines District, 3,500 ft.

Bambusa magica Ridley in Journ. As. Soc. Straits 44 (1905) 208, Mat. Fl. Malay. Pen. III, 184 ; E. G. Camus Bambusées (1913) 122.

Stems about 7 m. high, 12 mm. diam. or less, slender. Branches fascicled at the nodes. Leaves lanceolate, acuminate, glabrous, 7·5 by 1·2 cm., slightly scabrous on the edges, attenuate at the base into a short petiole. Culm-sheaths with 2 ciliate auricles. Flowers in a short panicle. Spikelets lanceolate, 19 by

6 mm. Empty glume ovate-lanceolate, flowering glumes lanceolate-mucronulate the upper one with ciliate keels. Lodicules 3, lanceolate, ciliate on the edges.

Loc. : Perak : Gunong, Berumbien (Wray).

Bambusa Copelandi Gamble in Brandis Ind. Trees (1911) 671; E. G. Camus Bambusées (1913) 127.

Vern. name: Wagyi (Burm.)

A large species. Culm-sheaths thick, with scanty black hairs outside, polished inside, 38 cm. long, top rounded towards the short and narrow blade. Leaves ovate-lanceolate, 33-88 by 4·5-6·6 cm., nerves 21-26 on $\frac{1}{4}$ in. Spikelets glabrous, 25-38 mm. long-empty glumes 2-4, with conspicuous transverse veins, flowering 2-3, longitudinal nerves 26, transverse veins, obscure; pale keeled and shortly bidentate at the apex; lodicules lanceolate, hyaline. Anthers 6 mm. long, mucronate at tip. Ovary and style hirsute. Caryopsis 12-16 mm. long, contracted towards the apex.

This species resembles *Dendrocalamus latiflorus* Munro in general appearance; it is of uncertain position in the genus.

Loc: Largely cultivated in the Northern Shan States (Brandis).

Bambusa elegans Ridley in Journ. As. Soc. Straits 44 (1905) 209, Mat. Fl. Malay. Pen. III, 185; E. G. Camus Bambusées (1913) 127.

A small climbing bamboo. Flowering branches purple all over. Leaf-bearing branches 30 cm. long in verticels distant 25 cm. from each other, provided at their base with numerous bracts. Leaves lanceolate-acuminate, 5-9 cm. long, 12 mm. broad, finely nerved; petiole short, ligule oblong, short. Inflorescence consisting of many spikes which are not verticillate. Bracts oblong, large, pale when dry, the outer one about 12 mm. long, the inner smaller, ovate, mucronulate. Spikelets 12 mm. long comprising 5 empty glumes at the base; flowers 5 mm. long; lower glumes lanceolate, green, purple towards the apex and ciliate on the edges; upper glume not keeled, ciliate on the edges, surrounding a cylindric-conical ovary; stigmas 2, short; no pales; 3rd flower male. Stamens 3; filaments very short; 4th and 5th flowers more or less incomplete, sterile.

Loc.: Malay Peninsula: Selangor; Semangko Pass (Burn-Murdoch).

SPECIES DUBIÆ.

Bambusa Mastersii Munro in Trans. Linn. Soc. XXVI (1866) 113; Gamble Ind. Bambus. (1896) 56:—Brandis Ind. Trees (1911) 681 thinks it might be a *Dinochloa*.

Bambusa marginata Munro (Gamble Ind. Bambus. 56).—Brandis Ind. Trees (1911) 681 is inclined to put it under *Dinochloa*.

Bambusa Kyathaungtu E. G. Camus Bambusées (1913) 116.—*Bambusa* No. 8 Brandis Ind. Trees (1911) 669.

Vern. name: Kyathaungtu-Thaiktu (Burm.)

Tufted, 15-18 m. Internodes 45-60 cm. long, densely clothed with white silky hairs, walls 19 mm. thick, often nearly solid, nodes with a ring of rootlets like *B. Tulda*. Spikelets polished, 3-4-flowered, purple at the apex, pale not or very slightly ciliate at the keels; lodicules broad, base fleshy, anthers purple, emarginate. Ovary obovoid, hairy, stigmas 3, long, plumose, sessile or nearly so.

According to Brandis this species is similar to *Bambusa polymorpha* Munro and *B. Tulda* Roxb. The seedlings resemble those of *B. Tulda*, but the nerves are closer together, 39-45 on $\frac{1}{4}$ in.

Loc.: Pegu: Bawben forests (Troup).

Bambusa Wamin E. G. Camus Bambusées (1913) 135.—Wamin Brandis Ind. Trees (1911) 685.

Vern. name: Wamin (Burm.)

Culms loosely tufted, erect or bending, up to 12 m. high, usually smaller, dark green, shining and perfectly glabrous. Internodes 10-15 cm. long, rarely longer, much swollen in the lower half, the swollen part 10-12·5 cm. diam. Rootlets on the lowest 3 or 4 nodes. Culm-sheaths resembling those of *Bambusa vulgaris* Schr., brown-hairy outside, 12·5 cm., blade 5-7·5 cm. long, with 2 rounded, ciliate auricles at the base. Leaves 18-23 by 2 cm., nerves 30-33 on $\frac{1}{4}$ in.; sheaths keeled, edges minutely ciliate. It is not impossible that the short swollen internodes are a deformity (see Kurz in Ind. For. I, 252, t. 1.).

Loc.: Cultivated in gardens in the Northern Shan States. Said to have been introduced from China or from Chengmai in Siam (Troup).

Bambusa himalayensis Hort.; E. G. Camus Bambusées (1913) 136, pl. 37, f. D. Camus refers to M. L. de Vilmorin in Bull. Soc. Dendr. Fr. (1909) 86.

Stem rather stout, yellow. Leaves large. Culm-sheaths resembling those of *B. longispiculata* Gamble, but smaller.—*Quid est*?.

Bambusa Thalaw-wa E. G. Camus Bambusées (1913) 135. Thalaw-wa, Brandis Ind. Trees (1911) 685.

Vern. name: Thalaw-wa (Burm.)

Tufted, culms light green, with minute white silky hairs, erect, 12-15 m., internodes 45-75 cm., 7.6-10 cm. diam., walls 8 mm. thick, small branchlets at most of the nodes. Culm-sheaths thick, nearly glabrous, 12.7—15 cm. long, 30 cm. wide at base, the sides curving to a slightly concave top, 10 cm. broad, with a brown fringe, blade triangular, on the inside densely clothed with brown hairs, sharply cuspidate, base 38 mm. Leaves 18-23 by 2·5 cm., nerves 25 on $\frac{1}{4}$ in., transverse veins visible, oblique, distant.

Loc: Cultivated in the Northern Shan States, 2,000-4,000 ft. (Troup).

Bambusa Sinthana E. G. Camus Bambusées (1913) 135.—Sinthana, Brandis Ind. Trees (1911) 685.

Vern. name: Sinthana (Burm.)

Culms erect, clothed with light brown silky hairs, which are matted together like felt near the nodes, 15 m. high, internodes 38-60 cm. long, 8·8-10 cm. diam., walls 12 mm. thick, rootlets at the lowest 3 or 4 nodes. Culm-sheaths 18-25.4 cm. long, brown, hairy outside, blade persistent, ribbed on the outside. Leaves, densely clothed with fine hairs beneath, 15-20 cm. by 12-16 mm., nerves 21 on $\frac{1}{4}$ in., transverse veins distant.

Loc.: Pyinyaung forests, Meiktila District, along banks of streams and on low, moist ground (Troup).

(*To be continued.*)

(ADDITIONAL NOTES BY R. N. PARKER, F. C. H., FOREST BOTANIST, DEHRA DUN.)

I have taken the opportunity afforded by the above article to add a few notes on certain bamboos.

Arundinaria falcata, Nees. flowered gregariously from Simla to Mussoorie in 1916. Gamble's statement that a few clumps of this species may be found in flower almost any year is doubtful. Except for one collected by Oliver in 1899 all our flowering specimens date from 1879 or a year or two earlier or later and from 1914-1916.

Arundinaria Gallatlyi, Gamble. Mr. Parkinson has collected on Mulayit ridge, Amherst district, a bamboo which agrees with Gamble's very inadequate description. If they are the same Gamble's description requires the following additions :—

An erect tufted thorny bamboo, culms 5-8 m. high, a ring of short spines at the nodes which are glabrous. Inflorescence a short loose panicle terminating leafy twigs. Spikelets solitary up to 4 cm. long, on slender glabrous pedicels, empty glumes 2, flowers 4-6 and a terminal imperfect flower ; rachilla 12 mm. long, hairy and ciliate in the upper half, callus shortly bearded ; empty glumes, the lower 5 mm. long, 3-nerved, lanceolate, shortly ciliate and minutely ciliate on the nerves, acute, the upper 7 mm. long, broader than the lower, 9 nerved, minutely ciliate, acute ; flowering glumes 10 mm. long, lanceolate, sub-acute, 9-nerved, shortly ciliate towards the tip otherwise glabrous, palea 10 mm. long, 2-keeled and minutely pubescent between the keels, tip bifid Lodicules 2 ovate lanceolate, the third linear-lanceolate, all long ciliate.

This species is very similar to *A. Griffithiana*, Munro. Parkinson's specimens unfortunately do not show the stamens, ovary or caryopsis.

Bambusa.—The group *B. tulda, nutans, teres* and *burmanica* is very unsatisfactory. Of these we know no more of *teres* now than when Gamble wrote his Indian Bambusæ. Gamble in his key distinguishes *nutans* and *teres* by the anthers being apiculate in *nutans* and penicillate in *teres* but his figure drawn from Dehra

Dun specimens of *nutans* shows the anthers penicillate. I have examined fresh specimens of *nutans* from Dehra Dun and find the anthers penicillate as Gamble figures them. I suspect *B. teres* is the same as *nutans* and I do not know on what grounds Gamble describes the anthers of *nutans* as being either long apiculate or penicillate.

B. burmanica, Gamble was described from very poor flowering specimens and plate 33 fig. 3 and 4 are doubtful. Oliver who collected both the flowering specimens and the seed has left a note: "As far as I recollect the flowering specimens came from Katha district and the seed from Pakokku district and they are possibly quite different species". The species which gave the culm-sheaths figured by Gamble has been cultivated in Dehra for 39 years but not one of the numerous clumps has ever flowered. Until they do so the identity of the culm sheath figured by Gamble remains doubtful.

The recognition by Brandis of *B. longispiculata* does not simplify matters. This bamboo seems to be merely a form of *B. tulda* with large flowers and spikelets but, in the large series of specimens we have, it seems impossible to draw a satisfactory line between *B. longispiculata* and *tulda*. Both these are at times "tabindaings" or single-stemmed bamboos. We have a specimen "tabindaing anet" Parkinson No. 5070 which seems to bear the same relationship to *B. burmanica* that *B. longispiculata* does to *B. tulda*.

I suggest the following modification to Gamble's key for these species :—

Anthers obtuse	
Spikelets small	*B. tulda*
Spikelets large	*B. tulda* var. *longispiculata.*
Anthers apiculate	*B. burmanica*
Anthers penicillate	B. nutans (= ? *teres*).

Bambusa affinis, Munro Parkinson has suggested that Gamble's plate represents *Gigantochloa macrostachya*, Kurz. I believe this to be the case if not the leaves and culm sheaths of these two species are identical.

Bambusa arundinacea, Willd. flowered gregariously in Dehra Dun in 1836, 1881 and 1926 giving a flowering period of 45 years. The last flowering has been spread over several years and a few clumps have still not flowered but there was a decided maximum in 1926.

Bambusa auriculata, Kurz. Gamble has left a note on one of the Dehra Dun specimens of this as follows:—

"After working at this for a long time, I have come to the conclusion that I cannot separate it from *Oxytenanthera nigro-ciliata*, Munro."

TEAK PLANTING IN GORAKHPUR.

The following notes based on the last 5 years' experience of teak planting in Gorakhpur Forest Division are given, as they will be of some interest to the readers of the *Indian Forester* :—

1. *Seed.*—The local seed has consistently given as good results as that imported from Burma. The local seed is from trees planted more than 50 years ago from seed obtained from Burma and is therefore acclamatised. The Jhansi seed was also tried but it gave poor results both in the percentage of germination and development of seedlings.

Considering the fact that the local teak seed costs only annas twelve per maund for collection and delivery at site, against rupees fifteen for the Burma seed, only the local seed is now used.

2. *Nurseries.*—No permanent nurseries are made and no watering is done. Temporary nurseries are made in the forest area to be planted, by digging the area about 9″ deep and roughly levelling it up without extracting the stumps. No seed beds are made. The seed is broadcasted as evenly as possible in April-May and germination begins in the coming July. With one or two weedings in July and August good sturdy plants are obtained quite fit to be made into cuttings for planting out in the next rains. As an example of work of this kind, the unwatered temporary nursery of two acres made in the forest near Campierganj in 1928 may be mentioned. 110,000 teak cuttings

have been taken from this nursery and planted out in the rains of 1929 and a few thousand seedlings more are expected from it next year. The cost of the nursery was Rs. 54 as follows:—

		Rs.
Digging and levelling of nursery area	...	21
Collection, carriage and sowing of seed	...	15
Weedings	...	18

Watering of nurseries did not give any better results, and being much more costly has been given up.

3. *Planting of cuttings.*—This is another interesting feature of this division; the making of holes in the area to be planted in advance of the planting having been found as useless as it is expensive, has been given up. No regular holes are now made. At the time of planting, when the rains have set in and the ground is soft, a hole is dug 9″ to 12″ deep with the ordinary spade, the cutting is put in it and the earth round it is well pressed.

The cost of this new method of planting compared with that of the old method of planting, with holes made in advance in May when the ground is stiff, is given below:—

Old method cost per 100.		New method cost per 100.
(*a*) Making holes 9″ to 12″ deep with a special narrow spade	10 annas	6 annas.
(*b*) Planting of cuttings in the holes	5 annas	
Total ...	15 annas	6 annas.

The new method costs only annas six compared with annas fifteen for 100 teak cuttings and the saving thus effected in a division where about three hundred thousand teak are planted every year is considerable.

M. P. BHOLA, I. F. S.

Gorakhpur, *U. P.*

EXTRACTS.

"PUNCH" ON INDIAN FORESTRY.

A State of Bliss.

News of the paradise which is called in blue-books the Independent State of Arampur is spreading abroad, and even Simla is becoming alive to the fact that Arampur provides a happy existence for a number of officials. The latest arrival (temporary) was the cousin of somebody important and his alleged business was to reorganise the State Department of Forests.

Now our Forest Department is the model of what a department should be. It has a Conservator, a staff of excellent clerks and a whole room full of maps, upon which forest land is painted a delicate green. It has a library, composed mostly of German books telling the reader how to control the growth of a tree twenty years old or more. It has a stock of theodolites, measurers and technical instruments. It has a staff of forest guards, each duly entered by name in a roll and with their beats assigned and indicated on maps. In fact it has everything a forest department requires except forests.

The villagers are not convinced believers in the economic doctrine of Abstention. They are misguided enough to hold that it is more important for them to have a fire on cold nights than for the State or the Conservator to be able to sell some planks thirty years hence. The result of this economic heresy is that the saplings' careers are cut short; an embryonic forest is maintained as an anæmic coppice.

Our expert from Simla had a Simlaesque knowledge of India; that is to say, he behaved as though the office were the Department, complete in itself without any reference to physical facts.

He was not one of those hard-headed pioneer people who ride out at 4 a. m. to see things for themselves. He probably recognised that he could see nothing at all except from an office-table and he was wise enough to recognise his own limitations. Simla teaches a man a great deal.

So, poring over the maps, he was able to point out how the forest-land might be more advantageously divided; how the forest rounds might better be allocated and how the planting projects might be improved. He devised a scheme for planting teak in place of the indigenous babul and neem, having been informed by the hydrographic chart he had brought with him that the local rainfall was more than sufficient for the growth of teak trees.

Well, we knew that chart and we knew the man from Simla who prepared it. While he was in Arampur he kept his rain-gauge outside his verandah and every day the gardener, conscientiously filling the flower-pots with water, gave a copious supply to what he deemed to be an extra pot. The meteorological expert returned to Simla with some astounding records of nightly rainfall which he eventually incorporated in the chart.

We said nothing, for that chart had been the means of keeping away many persons who have a dislike of rain. It made our positions more secure. Still we had not foreseen that this happy error might eventually result in a laborious planting of teak which could never grow up. Besides, if the thing were actually attempted, it would spoil the rough jungle for the panther and our sport would suffer. Further, half-a-million teak trees landed at Dhuligaum, where the Arampur State Railway joins the British India system, would have paralysed the goods traffic and possibly stopped our supply of ice. And, even supposing that a goodly number of the plants were removed *en route* for firewood, we should still have more than the paper-foresters and guards could deal with. Then, if we succeeded in planting the lot on paper, the State might have to pay some outside authority for the beastly things. Though the Forest Department is in a flourishing condition (as you may see from its yearly accounts) it would be difficult to pay a considerable sum outside the State. Debits and

credits between State Departments are treated as arrangements between gentlemen, but Simla is often ill-mannered enough to call for cash.

So the Resident buttonholed the expert and told him confidentially that the State was very jealous of its rights, and he therefore suggested that the plants be left for the State Conservator to order. Full weight would of course be given to the expert's recommendations, and in a year or two, when the newly planted teak was coming along nicely, the first of its probable fruits would be a C.S.I. for the expert.

The Resident then gave him the names of some distant States whose forest systems needed overhauling, and we all saw the expert off at the station with many expressions of cordiality and good-fellowship.

All that remained to be done was for the Conservator's third clerk to achieve some imaginatively artistic work in vermilion, indicating teak, on the maps. We are again ready for inspection.

E. P. W.

(*Punch*)

VOLUME TABLES FOR INDIAN TIMBER.

It is only during the present century that the preparation of growth and volume statistics has been commenced in the forests of the British Empire; and its inauguration was due to the Indian Forest Service. Statistics of the kind are now available for some of the more important timber species of India and Burma, such as deodar, sal, and teak. In a recent number of the Indian Forest Records (Vol. XIII. Part 3, Silviculture Series, 1928) commercial volume tables for sal (*Shorea robusta*) in the wet mixed forests of the Bengal Duars are published. Several volume tables for this species are already in existence, but they relate chiefly to the growth of this tree in the drier climate of the United Provinces. The latter tables, it is considered, can be safely applied to the drier types of Bengal sal forest, as also to similar forests in Assam. They are inapplicable, however, to the moist type and it is for this latter that the new tables are

designed. The preparation of such tables involves considerable field work in connection with the measurement of the crops on selected areas of forest, work in which the compiler, Mr. Parma Nand Suri, Statistical Assistant to the Silviculturist of the Forest Research Institute, was ably assisted by the local forest staff. The same officer has also prepared (Indian Forest Records, Vol. XIII, Part 4, 1928) a set of tables, the first of their kind, for the sundri (*Heritiera Fomes*) in the Sundarbans, the Gangetic delta south of Calcutta. These tables have been drawn up for the two types of sundri forest, the salt-water type and the fresh-water type. They should prove of great assistance in estimating the outturn of coupes and volume of growing stock. In connection with the Sundarbans sundri volume tables, Mr. H. G. Champion, Silviculturist at the Research Institute, writes in a preface : " Since the work was begun there has been published Burma Forest Bulletin No. 15 (December 1926), a quarter girth volume outturn table for this species, for the Delta Division of Burma......There is a very fair agreement in the small overlapping portion, suggesting that if larger trees are grown in the Sundarbans the Burma figures may prove useful. Both pamphlets are illustrated and furnish evidence of the great strides made in the scientific aspects of forest work in India. (*Nature*).

EROSION AND DESICCATION IN THE PUNJAB.

The most insidious and least realized, but undoubtedly the most serious, danger with which large parts of the Punjab are confronted is erosion followed by desiccation. It is undoubtedly true that man, with his flocks and herds, has been, and still is, the prime agent in the creation of this danger through the destruction of forests of enormous protective value to the Province by promiscuous and uncontrolled firing, grazing, browsing, lopping and felling of trees ; yet Nature tends to become a secondary agent in so far as the destruction caused by man is followed, on the disappearance of protective forest growth, by further deterioration of conditions by the gradual, but ultimately equally complete, desiccation of the region affected. In spite of the evils that have fallen upon whole regions such as Iraq, Persia, Spain and large

parts of south-eastern Europe the layman in India is slow to recognise the spread of the evil of erosion and desiccation which goes on before his eyes; and the warnings of forest officers are ignored, or at best looked upon with mild suspicion as exaggerated and interested. It is, therefore, a matter of no small satisfaction to the Department that the Punjab Government has during the year, initiated a serious investigation by a special Forest Officer of the conditions now prevailing in areas specially subject to erosion and desiccation such as the Siwaliks, Hoshiarpur *Chos*, Gurgaon hills, and large parts of the Salt Range and neighbouring foot hills. It is hoped that, when the results of this investigation are put into final shape for consideration by Government, serious and adequate action (already too long delayed) will be taken to save important sections of the population from certain ruin. Already the damage done is irremediable over extensive areas, and unless action is taken soon still greater areas will be depopulated: nothing could be more dangerous than to delay action in the hope that the conscience of a more enlightened generation may in due course be awakened. It is not possible here to give any definite estimate of the serious extent to which the Punjab has already suffered from this evil, but it would afford a very incomplete record of the forestal position of the Province if the subject were not emphasised in this report. It will be understood that these remarks refer principally to areas which lie outside the control of the Forest Department. The forests under the control of the Department are generally speaking well protected, though protection is a very difficult matter owing to the pressure of the population and the heavy rights with which many of the forests are burdened. In some tracts, Jhelum for instance, the reserved forests form the last remaining reserves of fodder in the district.

(Progress Report on Forest Administration in the Punjab, 1927-28).

STEEL SLEEPERS.

As one who has travelled many thousand miles in railway trains in West Africa, where metal sleepers are used of necessity

and railway travel is a penance to be borne patiently, I think I may say, without fear of contradiction, that the noise in consequence is maddening and makes one think with longing of the smooth, silent expresses at home running over beautifully laid tracks on wooden sleepers. I would respectfully submit that should our railways at home decide to replace good timber sleepers with metal ones they will drive away to the motor coaches those staunch supporters of railway travel who still prefer the peace and quietness of a comfortable railway coach to the hooting noises and petrol scented dust of our modern roads.—Captain the Master of Gray, Naval and Military Club.

(*The Times.*)

APPOINTMENT OF TIMBER ASSISTANTS FOR BURMA.

The Government of Burma invite applications for two appointments as Timber Assistant for the Utilization Forest Circle, Commercial Concern, Burma.

Candidates must be unmarried and must produce evidence of having received a good general education of British Public School standard, and satisfy the High Commissioner for India that they are in all respects suitable for appointment under the Government of Burma. They must be prepared to proceed to Burma in the autumn of this year. Their age must not, without exception on any ground, be less than 18 or more than 22 years on the 1st August, 1929.

Agreement for five years with prospect of continued employment. Pay: First year Rs. 550 a calendar month, rising by annual increments of Rs. 50 to Rs. 1,000 a calendar month (approximate sterling equivalent per annum Rs. 550 = £495 1,000 = £900). Free passage to Burma. Provident Fund, with Government contribution of 100 per cent. Travelling Allowances. Strict medical examination.

(*The Times.*)

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INTERNATIONAL CONGRESS OF FOREST EXPERIMENTAL STATIONS, STOCKHOLM.

An International Congress of Forest Experimental Stations was held at Stockholm from July 21st to 27th 1929, at which the chief work was the revival of the previous international union and the drafting and adoption of the new statutes. After considerable discussion the statutes were finally approved.

The forests of Sweden consisting of Scots pine (*Pinus silvestris*) Norway spruce (*Picea excelsa*) and birch (*Betula alba*) are very similar to those of Eastern Canada. Both occupy a heavily glaciated country with a low profile and many lakes and rivers. More than half the country is covered with forest and this has all been brought under management. It is a remarkable fact that although forestry is here carried on on very extensive lines the devastation by fire and axe which is such a feature of North American scenery is no where visible. Sweden is prepared to continue indefinitely her valuable trade in forest products; her timber goes as far as Australia and no doubt she will soon be exporting spruce pulp to North America if she is not doing so already. From a silvicultural point of view the rather open character of the woods, their irregularity and the mixture with birch is most interesting; the age-classes are not arranged in solid even-aged blocks and regeneration fellings seem to be very elastic. The birch is now considered to be of fundamental importance in the maintenance of soil fertility. The Scots pine is of superior quality with a long straight bole

and narrow crown and a large percentage of red heartwood, but it does not grow to any great size. An underwood of spruce is generally present and the tendency is to increase the proportion of spruce on account of its superior volume production. Great importance is attached to thinnings, and the forest research branch has shown that by thinning a larger total volume production and a greater increment per cent. is obtained. The woods of Sweden are not nearly so artificial as those of Germany; natural regeneration is aimed at and appears to be obtained without much difficulty and the broad-leaved mixture is insisted on. There is therefore little fault to find with their forestry judged from the latest fashions in forest management. Whether this class of wood produces the same volume per acre as the denser and more even-aged woods of Central Europe quality for quality is a question which would raise a pretty controversy.

Here we have a country carrying out extensive forest operations competing with the virgin forests of North America in the markets of the world which has not found scientific forestry incompatible with large scale production, a country in which the bogey of sustained supplies of raw material does not exist. Would that the same could be said of all parts of the British Empire.

C. G. T.

WEST ALMORA DIVISION, U. P.

By J. E. C. Turner, I.F.S.

The Division lies about the centre of what is known as the Kumaon Commissionership in the United Provinces. It is reached by an excellent motor road from Kathgodam terminus on the Rohilkhand and Kumaon Railway ; Ranikhet is about 50 miles from there and Almora 32 miles further on. An alternative route is by a good bridle path *viâ* Bhim Tal, Ramgarh and Peora, the distance to Almora, which is the headquarters of the Division, being 37 miles.

There is a regular motor service from railhead and numerous motor cars and buses ply for hire.

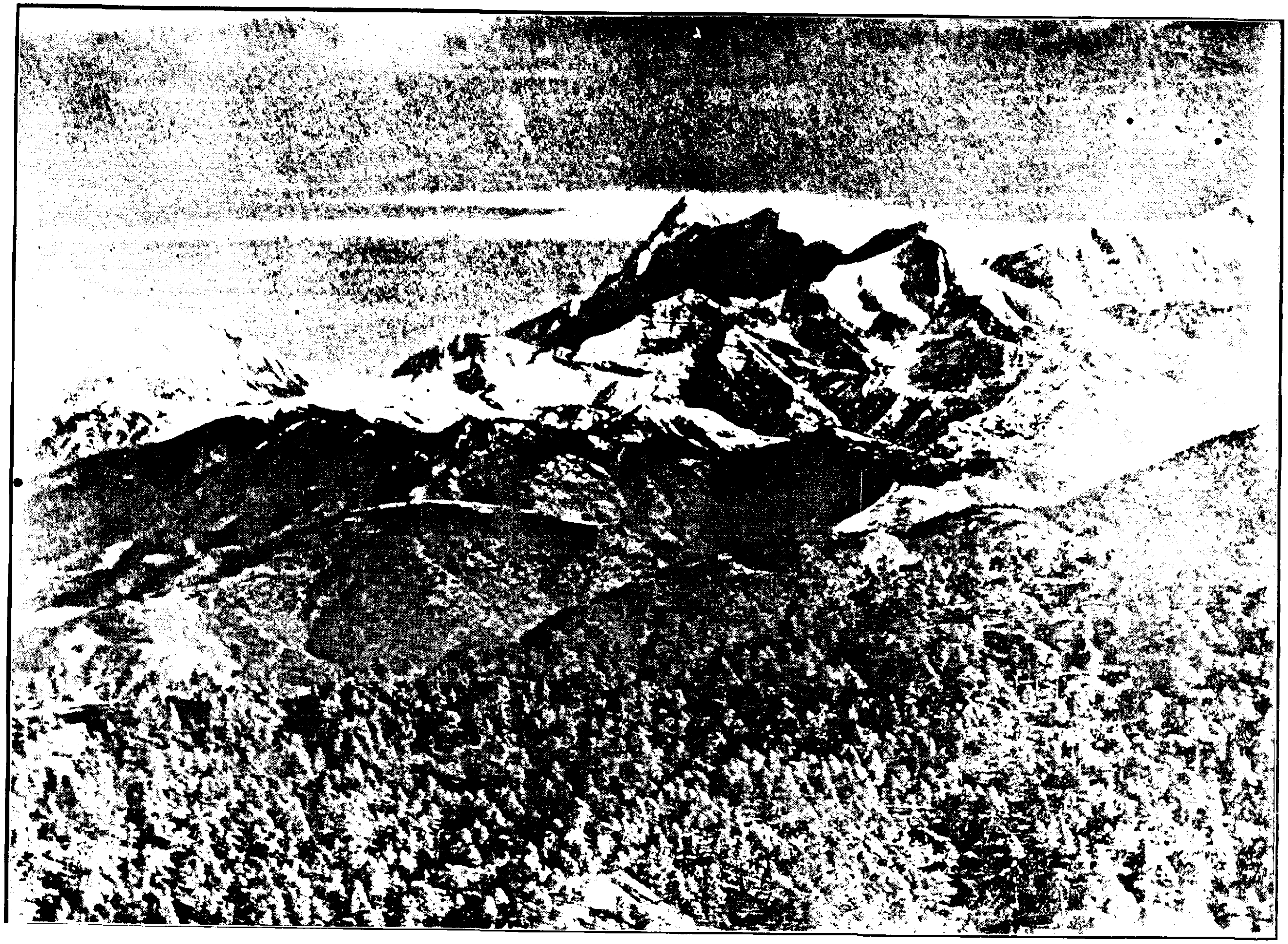

Photo by J. E. C. Turner, I.F.S.

The scenery from West Almora Division is magnificent. The mountain shown in the middle of the photograph is Trisul, 23,406 feet above mean sea level. It receives its name from the three snowy peaks named after a religious Hindu trinity composed of Mahalakshmi the goddess of Wealth, Mahakali the goddess of Destruction and Mahasaraswati the goddess of Learning.

Ranikhet is a large military station accommodating during the summer from 2,000 to 3,000 British troops of all branches of the Army, from infantry to cavalry and Tank Corps; there are hotels and boarding houses. While at Almora there is a dák bungalow.

Kumaon was annexed in 1815 by the British who ousted the Gurkhas in a series of engagements, one of the final battles taking place at Garanath in April of that year; on the exact site of the struggle there now stands a Forest Rest House midst charming sylvan surroundings. West Almora, as a separate Division, came into being in the year 1915; later, in 1920, it was partitioned into Central Almora and Ranikhet Divisions; a further vicissitude was in store in 1925 when these two charges were amalgamated.

The area of the forests is 408 square miles, the Division including part of the Garhwal District. The slopes of the hills are generally moderate in the centre and east; but in the west, in the upper part of the Ramganga catchment area, the hillsides are steep to precipitous and demand hard physical effort during forest inspection. There is but one lake, known as Tarag Tal. Altitudes vary from 2,296 feet above mean sea level to 11,400 feet. Thus there is not one climate but many. The valleys are very hot in summer. Generally speaking, the best climate al the year round is that associated with an altitude of about 6,000 feet where the *chir* pine and oak grow together. This companionship is the best index in Kumoan of an ideal climate with an annual rainfall of about 45 inches. A fine example of such a perfect climate is Ranikhet. Indeed, it is known that had Lord Mayo lived to return from his tragic visit to the Andaman Islands, Ranikhet, which had enchanted him, would have been today the summer capital of the Government of India. And a better modern capital than Simla it would have made since all the roads are motorable; moreover, there is abundant scope eastwards as well as westwards for expansion on modern lines, including possible landing grounds for aircraft.

The geology of the Division is interesting. Nearly half of the area holds varieties of schistose rocks, the forms running into

one another. Mica is nearly always noticeable in these schists, sometimes in tiny crystals. Slates and shales occur here and there; the former sometimes making a good roofing material. In the neighbourhood of Almora town there exists a famous quarry which has supplied excellent slates for nearly every building within municipal limits. Gneissic masses are common in the forests, a typical form being granular in texture and pinkish in colour. Quartzite is far less met with; it occurs in bands among the schistose formations. Limestone outcrops in two belts; there are two types, and in one of these road-making is very difficult as the rock is not easy to break or blast. Usually throughout the tract the soil is light sandy with a deficiency in depth and moisture.

West Almora Division is highly developed in the matter of roads. Every valley and nearly every hill is accessible by bridle paths. In the forests alone there are, on an average, approximately two miles of roads in a square mile. Both Tibet and Nepal can be reached by roads fit for riding and pack-ponies. A serviceable bridle road takes many visitors annually to the Pindari glacier which is situated about 70 miles from Almora.

There are 30 Forest Rest Houses, 23 Staging Bungalows under the District Board, 9 Inspection Bungalows in the care of the Public Works Department and 4 on the Kausani Soldiers' Settlement Estates for which the Deputy Commissioner is responsible.

Supplies are not easy to obtain. It is wise to make all arrangements beforehand in central places, like Ranikhet and Almora, and then to proceed fully rationed to the delightful interior. There are cooly agencies in both the above named places. These supply transport, but good notice must be given as the demand for labour in summer is usually great.

The question of supplies has been made more difficult in recent years, especially in the western part. In the olden days, the *doms*, who are the so-called depressed classes here, used to rear poultry. But a caste revolution has been gradually but surely gaining ground. The *doms* are now taking to wearing the sacred thread (known locally as *janeo*) of the Rajputs and Brahmins, thus elevating themselves in the social scale and

simultaneously abandoning all business in eggs and chickens. The tourist must accordingly bear this revolution in mind, and add to his commissariat tinned substitutes for fowls. It is always safe even in the hills to boil water; this precaution should not be overlooked, especially as these mountains have been brought by increasing motor traffic so much nearer to the plains whence now easily and quickly come epidemics like cholera.

To the botanist on a holiday, untramelled by heavy bundles of official papers, West Almora Division is a perfect paradise. He may wander for hours up and down the ravines and along the hill-sides making hosts of fresh floral acquaintances. He may go higher and higher into the mountains and continue to add to the list. The two main species in this Division occur roughly in separate altitudinal zones: *chir* pine (*Pinus longifolia*) from 2,500 to about 6,500 feet, and oak (*Quercus incana*) from 4,000 feet to about 8,500 feet. Each of these species forms extensive forests by itself and covers large areas. With the oak, but not in large numbers, are found *burans* (*Rhodo dendron arboreum*), *aiyar* (*Pieris ovalifolia*). Occasionally two other oaks associate with *Q. incana*; these are *rianj* (*Q. lanuginosa*) and *phanyanth* (*Q. glauca*). At higher altitudes, such as on Bhatkote peak, 9,086 feet, there is silver fir (*Abies Pindrow*), the vernacular name of which is *rage* in some localities and *raunsal* in others. Here, too, are the high level oaks, (*Q. kharsu, semicarpifolia*) and *tilonj* (*Q. dilatata*). The deodar (*Cedrus Deodara*), a variety of the biblical cedar of Libanon, is not indigenous but is planted round temples and is looked upon as a sacred tree.

The tiger is found at all altitudes up to 10,000 feet above sea-level. Some tigers never leave the hills, while others, which come up from the sub-mountane tract in summer to escape the heat and flies, return to the sal (*Shorea robusta*) forests in the winter. Those which make the hills their permanent abode, and breed there, not infrequently turn man-eaters. Indeed, it is officially on record that in the earlier years of British rule certain tracts were almost deserted on account of man-eating tigers. The destruction of tigers in the Division is encouraged by the offer of a reward of Rs. 50 for each one killed.

The panther is common throughout the locality. When this animal takes to killing human beings he proves to be a worse enemy than the tiger on account of his excessive daring, for he fearlessly enters the villages and even snatches his victims from the very thresholds of their doors. For each panther destroyed a reward of Rs. 30 is given. Of the remaining carnivores brief mention must be made of the wild dog. This animal is sometimes met with in small packs; a reward of Rs. 30 is given for each one killed.

The Himalayan black bear (*Ursus torquatus*) is frequently seen in certain forest blocks which contain mostly oak trees. His food in the winter is acorns; occasionally the sportsman is able to shoot him in a tree.

The herbivores are represented by the *gural* or Himalayan chamois usually found on precipitous slopes between 4,000 and 9,000 feet, both sexes having horns. The habitat of the *thar* is the higher ranges up to about 13,000 feet; in this species also both males and females have horns. The *serow*, which belongs to the same family as the *gural*, is a strange, shy beast frequenting remote tracts clothed with dense jungle. The *kakar*, or barking deer, is found in the same altitudinal zone as the *gural*, but usually affects oak forests with a thick undergrowth. For the benefit of the sportsman who is attracted by high level shooting the *barhal*, or wild blue sheep, which lives near the snow line at about 16,000 feet, may be briefly alluded to; these animals sometimes require a considerable amount of stalking; great endurance and almost infinite patience are demanded at time before a shot with a reasonable prospect of success can be got.

The avifauna is of absorbing interest to those who love bird life. Many pleasant hours may be spent watching their habits, some migratory, others not so. Most beautiful of all is the Paradise Fly-Catcher (*Terpsiphone paradisi*), which, as Whistler rightly says, "for sheer beauty of contrast and purity of coloration and for grace of form and movement, the adult male must be without a rival in India". Other common migrant birds are the Verditer Fly-Catcher (*Stoparola melanops*), the King-crow (*Dicrurus macrocercus*) ever pugnacious and aggressive, the wire-tailed

Swallow (*Hirundo smithii filifera*) with its sweet little song and constant twitter. Amongst the resident species are the Red-vented Bulbul (*Molpastes haemorrhus*); the Scarlet Minivet (*Pericrocotus speciosus*) a purely arboreal species flitting from pine tree to pine tree with its rich plumage glinting in the sunlight; the Whistling-Thrush (*Myiophoneus temmenckii*) which sings joyously in the depth of winter in the coldest of ravines.

Among the game birds are the *kalij* pheasant, the *chir* pheasant, the beautiful *moonal*, the *chakor*, the black partridge, and pigeons; all of these have close seasons.

There are eight ranges in the Division. The Ranikhet Cantonment forests form a ninth since the Divisional Forest Officer is responsible for all scientific work carried out in them. He is also technical adviser in forestry to the Almora Municipality.

Very briefly, both the principal species, *chir* pine and *banj* oak, are subjected to the system of silvicultural treatment known as the Uniform Method. In other words, the aim is to rear new crops of a uniform age by the gradual and cautious removal of the old woods. In pine forests this aim is achieved provided adequate attention is paid to artificial regeneration wherever necessary, and to efficient fire-protection; a third *desideratum* which is proving of increasing importance is the eradication of the fungus *Peridermium* which is undoubtedly spreading amongst young crops. *Banj* oak presents real difficulties in raising a new crop, especially on northern aspects under oak. On southern aspects and on dry, sandy, bare, northern slopes encouraging success has followed sowings.

The Division has many excellent pine plantations all of which are thinned on a definite rotation.

From the large commercial areas sleepers for railways and for general trade purposes are extracted and floated down to railhead at Tanakpur. In the forests near Almora and Ranikhet house-building timber of all sizes is converted from standing trees auctioned annually.

Firewood and charcoal in large quantities are prepared annually to meet the demands of the military and public in Ranikhet and Almora.

In addition, there is the important resin industry which is responsible for supplying any quantity of crude resin from 50,000 maunds to 90,000 maunds annually. West Almora is the most important resin division in India. All crude resin is despatched to the Indian Turpentine and Rosin Company's factory at Clutterbuckganj.

A large number of minor forest products are collected at suitable seasons throughout the year and exported to the plains. There are herbs of medicinal value, lichen for dyeing, roots and edible fruits.

The Division is densely populated. The people are dependent in a large measure on the forests; the interests of both are inseparable. Administration, in consequence, is not a matter of such plain sailing as it is in many of the divisions in the plains. In West Almora it is essential to proceed with the utmost caution and forethought in all schemes to avoid clashing with the people's interests. In the political arena the forests take a prominent place. Indeed, during a recent election, when the writer was a Presiding Officer at a large polling station, one of the candidates for the Legislative Council made the subject of forests the chief item in his list of promises to the electorate.

Translated with a moderate measure of poetical licence, his slogan, broadcasted in the form of a couplet, was—

"If you desire disforestation,
Vote for me, I'll bring you elation."

The promise served its purpose and secured many votes, but was, of course, impossible of fulfilment.

In the manufacture of forest grievances, and preparation of petitions to appellate authorities, the people are experts. When a monster petition is compiled there are no qualms of conscience about forged signatures; and if thumbs of the illiterate run short for the correct number of impressions to make the document sufficiently impressive then toes are resourcefully and humorously requisitioned.

A study of village life will show the observer that the women do most of the work. They perform household duties, go to the

forests and collect grass, leaf-fodder and firewood; they also do all the agricultural work, except ploughing. It is not an uncommon sight to see the women toiling in the fields, unprotected from heavy rain, while their husbands sit idle either in their houses of smoke and gossip at the nearest wayside shop. At present, conditions are very much against the weaker sex; there is unlimited scope for genuine and selfless social workers among the men to form an active Women's Emancipation League.

Educational institutions are universal and illiteracy is disappearing. With this disappearance there is coming more and more into evidence a general levelling up amongst the several social classes. Complete social equality will doubtless take time; but education is the one instrument that will eventually bring it about and reveal to the sufferers the absurdities of the existing inferiority complex in the local social sphere.

To the visitor from the plains the most striking feature about local agriculture is the methodical terracing of the hill-sides; sometimes a hill from the very summit to the river below may be noticed completely terraced for agriculture. The terraces represent the labour of generations. The best crops are grown in the valleys where most of the land is irrigated. The fields are everywhere dependent for their continued fertility on litter obtained from the forests; without such manure the soil rapidly shows signs of deterioration. Land in the valleys is very expensive, the current selling price being between Rs. 2,000 to Rs. 3,000 per acre. The winter crops are wheat and barley, while those reared in the summer and harvested in the autumn are chiefly rice, *madwa* and cereals. The breed of cattle is usually very poor; many of the animals are mere manure-making machines. The valleys and hill-sides look their best in the rains when they are clothed in pretty emerald green which charms the eye of the traveller.

The best shooting is obtainable in what are known as the *old* reserves; here there are restrictions and control. But in the *new* reserves game is rapidly being destroyed. Any holder of a gun-licence may enter and destroy as many animals as he likes.

If the preservation of the fauna is a consideration then the policy is manifestly cruelly unsound.

For the *old* reserves a permit from the Divisional Forest Officer is necessary, but not so in the case of the second category.

Piscatorially, there is good sport in the Division. The principal rivers are the Kosi, Sarju, Gumti and Ramganga. Both *mahseer* and *kalabans* are obtainable. Unfortunately, there are no rules to preserve fish in these hill tracts, with the result that indiscriminate netting, spearing and shooting take place by the villagers.

The scenery visible from West Almora Division justly takes rank with the finest in the world. Here is a large field for the enthusiastic amateur photographer; but a telephoto lens and a suitable light filter must form part of his equipment. Throughout the autumn and winter, part of spring and occasionally in summer, there can be very clearly seen a magnificent panorama of snow-clad peaks of the holy Himalaya. Amongst these is the great Trisul, a Sanskritic name meaning trinity, 23,406 feet above mean sea level, climbed successfully in the year 1907 by those three super-mountaineers, Doctor T. Longstaff, M.D., and his intrepid Italian guides, the Brocherel brothers, Alexis and Henri. To the east, but beyond, stands sentinel-like, unconquered and unconquerable, the grandest peak of all, Nanda Devi, 25,660 feet. She is the highest mountain in the British Empire. She proudly surveys it; her vigil is sacred and everlasting; her majesty incomparable, infinite.

THE INDIAN BAMBOOS BROUGHT UP-TO-DATE.

BY E. BLATTER, S.J., Ph.D., F.L.S.

(*Continued from pages 541—562, October number.*)

GIGANTOCHLOA Kurz.

Gigantochloa macrostachya Kurz. (Gamble Ind. Bambus. 3).—See below under ? *G. toungooensis* E. G. Camus.

Gigantochloa heterostachya Munro (Gamble Ind. Bambus. 66).—Fig. 15 of pl. 57 (ovary with stigmas) is drawn from Ridley's specimen, and all the rest from the type-specimen collected by Griffith, No. 6731. The inclusion of fig. 15 drawn from a doubtful specimen is unsatisfactory, to say the least. Gamble says " With this [*G. heterostachya*] I also identify Ridley's No. 1717, *Bulu tilun*, with much larger and many-flowered heads. The plate was done from Griffith's specimen, and does not show the head quite so large or with so many spikelets as it should perhaps do." This shows that Gamble was not quite sure about the identity of Ridley's plant.

Gigantochloa compressa Parker in *Indian Foresterer*, LIV (1928) 98, pl. 10.

A large loosely tufted plant. Culms 12-18 m. long, 10 cm. diam., grey powdery when young, afterwards green; internodes about 60 cm. long, nodes marked by a sharp ledge after the fall of the sheaths, walls about 8 mm. thick. Culm-sheath half the lenght of the internode, persistent, rotting on the culms, covered with black hairs when young, apex rounded with inconspicuous auricles on either side, abortive blade small, lanceolate, reflexed, ligule extending to the full width of the sheath, fringed with long white bristles. Leaves 20-45 by 3·5-7·5 cm., glabrous above but somewhat scabrid towards the lower edge, glaucous and slightly pubescent beneath especially towards the base and along the stout yellow midrib, margins scabrid, apex narrowed into a long, twisted, scabrid point, main lateral nerves 7-14 pairs; intermediate veins 7; petiole 3-5 mm. long, stout, pubescent, sheath striate, grey-pubescent when young and sometimes also clothed with black bristles, ending in a pubescent callus beneath the petiole and usually 2 very small marginal naked calli; ligule 1-2 mm. long, fringed with white bristles. Inflorescence a leafless or sometimes leafy panicle. Spikelets arranged in discrete half-whorls of 2 or 3 fertile and several sterile spikelets in the axils of ovate or lanceolate bracts; rhachis densely grey-pubescent. Fertile spikelets 20-25 mm. long, 5—6 mm. broad, distinctly flattened or compressed consisting of 3-4 broadly ovate, mucronate, many-nerved empty glumes which are brown microscopically

pubescent or hoary and conspicuously black-ciliate, followed by 2-4 fertile glumes similar to the empty but larger, 15-20 mm. long and more distinctly mucronate, these followed by a glume containing an empty pale and sometimes another empty convolute glume. Pales 15-18 mm. long, strongly keeled and ciliate on the keels, the hairs grey in the lower half, black towards the tip which is rounded or minutely 2-fid, 5-or 6-nerved between the keels. Lodicules 0. Stamens 6-7, filaments united into a tube as long as the pale; anthers yellow or pinkish-purple, 9-13 mm. long, connective produced into a hairy point about 1 mm. long. Ovary narrowly cylindric, glabrous except at the top tipped by a long, slender, hairy style; stigmas 3, very slender, hairy (Parker).

Distribution: Mergui District, Nagawan reserve, common on low hills, also on the Yangwa klong (Parker 2624, 2629, 2633 2641, 2726).

SPECIES DUBIÆ.

? Gigantochloa toungooensis E. G. Camus Bambusées (1913) 140.—Tabindaing Brandis Ind. Trees (1911) 672, Suggestions regarding Forest Administration in British Burma (1881) 141.

Vern. name: Tabindaing (Burm.)

Culm-sheaths 15 cm. long, gradually narrowed from a base 20 cm. wide to an apex 10 cm. broad, a broad undulated band on both sides of the 5 cm. broad base of the triangular blade. Leaves 20 by 2-5 cm., glaucous and hairy beneath, nerves 30-36 on $\frac{1}{4}$ in.

"The *taungya* clearings made in forests of this species mostly grow up in bamboo, and the period which in 1880 was allowed for the bamboo forest to grow up, before it was cut again, varied from 7-15 years. To this probably belongs Kurz's No. 156, from Burma, without locality." (Brandis).

The above description was taken from the specimen collected by Brandis in the Karen Hills in February 1880, which was included by Gamble (Indian Bambuseæ p. 64) under *Gigantochloa macrostachya* Kurz. In Gamble's plate No. 54 the 15 figures except No. 4 and 5 were drawn from Brandis' specimens. Now

Gamble made use of two specimens gathered by Brandis, one of the Sittang Hills in flower (1862) and the other of the Karen Hills without flowers (1880). Therefore all the figures (*viz.* 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15) are correct, as they were taken from the flowering specimen of 1862; only No. 1 remains doubtful as we do not know whether it was drawn after the 1862 or 1880 specimen.

Loc.: Karen Hills south-east of Toungoo (Brandis in 1880).

?*Gigantochloa yunzalinensis* E. G. Camus Bambusées (1913) 141.—Tabindaing, Brandis Ind. Trees (1911) 672, see Suggestions regarding Forest Administration in British Burma (1881) 151, 153, 156, 157.

Vern. names: Tabindaing (Burm.); Wabgai, Wame (Karen).

Culms 60-90 cm. apart, bright green, often with yellow stripes, lower half naked; culm-sheaths thick, clothed outside with black irritating hairs. Leaves 20-30 by 2-4 cm., nerves 30-40 on $\frac{1}{4}$ in.

Brandis thinks it possible that Kurz may have based his *Bambusa villosula* (Gamble Ind. Bambuseæ p. 56) upon specimens collected by Brandis at an earlier date. But it is impossible to decide the question as *B. villosula* itself is very little known.

Loc.: Hills on the headwaters of the Maitharauk river, ascending to the crest of the Bithoko range, also in the Sinzway forest of the Yunzalin valley (Brandis, March 1880).

?*Gigantochloa mogaungensis* E. G. Camus Bambusées (1913) 141.—Tabindaing, Brandis Ind. Trees (1911) 672, (c).

Vern. name: Tabindaing (Burm.)

Culms single, at long intervals on the rhizome. Culm-sheaths and leaves similar to those of previous species.

Loc.: Upper Burma: Mogaung forests (J. W. Oliver, Feb. 1895).

?*Gigantochloa wunthoensis* E. G. Camus Bambusées (1913) 141.—Tabindaing, Brandis Ind. Trees (1911) 672, (d).

Vern. name: Tabindaing (Burm.)

Culms 60 cm. apart, naked below on $\frac{2}{3}$ of their length, 15 m. high; internodes 45 cm. long, 7·6—10 cm. diameter, walls 4 mm. thick, nodes not prominent, the culm, therefore, smooth, cylindric. Culm-sheaths 15-20 cm. long, from stone—to orange-colour, contrasting with the light-green colour of the culms, blade 5-10 cm. long. Leaves glabrous, glaucous beneath, 20-30 by 2·5-5 cm., nerves 25-33 on $\frac{1}{4}$ in. Accidental branches on the lower portion of the culm, and partially suppressed branchlets have leaf-sheaths with long bristles at the mouth, while the normal leaves on the upper portion of the stem are without such bristles, and have keeled naked sheaths.

Loc.: Upper Burma: Wuntho, in cool evergreen forest, 500 ft. (Smales, Jan. 1902) (ex Brandis).

?*Gigantochloa kathaensis* E. G. Camus Bambusées (1913) 141.—Tabindaing, Brandis Ind. Trees (1911) 673, (c).

Vern. name: Tabindaing (Burm.)

Culms 30-60 cm. apart, naked more than half-way up, 22·5 m high, a few conspicuous rings of arrested rootlets on the lowest 3 or 4 nodes. Culm-sheath very broad at base, 15 cm., blade 5-7·6 cm. long. Internodes 30-60 cm., 10 cm. diam., nodes thick with a conspicuous arrested bud at every node, 12—25 mm. diam. Leaves bluish-white beneath, 25 by 3·8 cm., nerves 29-37 on $\frac{1}{4}$ in., leaf-sheaths keeled; ligule large triangular.

Loc.: Burma: Hills west of Katha, 2,000 ft., in cool evergreen forest (J. Messer, March 1904).

Gigantochloa wanet, E. G. Camus Bambusées (1913) 141.—Wanet, Brandis Ind. Trees (1911) 673, (f).

Vern. name: Wanet (Burm.)

Culms tufted, stems branched in the lower half; culm, sheaths thick, not much narrowed towards the truncate mouth, with broad, wavy, fimbriate auricles. Leaves pale beneath and slightly velvety, 30 cm. by 38-45 mm.; ligule conspicuous, nerves 30-40 on $\frac{1}{4}$ in., petiole 4 mm. long.

Loc.: Upper Burma: Shwegu (Pocock, 1902).

?*Gigantochloa kachinensis*, E. G. Camus Bambusées (1913) 141.—Wanet, Brandis Ind. Trees (1911) 673 (g).

Vern. name : Wanet (Burm.)

Culm-sheaths woody, 20 cm. long, blade triangular as long as sheath, tip spinescent. Leaves 23 – 30 by 3 – 5 cm., glaucous and finely pubescent beneath, nerves 28-33 on ¼ in.; ligule very small.

Loc. : Burma: Kachin Hills, Bhamo District, in moist forest, 1,500 ft. (Oliver, April 1893).— This specimen must be excluded from Gamble's Bambuseæ under *G. macrostachya.*

?*Gigantochloa tekserah* E. G. Camus Bambusées (1913) 141.

Vern. name: Tekserah, Brandis Ind. Trees (1911) 673, (h).

Culm-sheath broad, blade 20 cm. long, membranous, glabrous, conspicuously ribbed, continued into a broad fimbriate band on the top of sheath. Leaves hairy beneath, 23 by 2·8 cm., narrowed into a petiole 5-6 mm. long, apex running out into a long, hairy point, nerves 40-45 on ¼ in.; ligule minute.

Loc.: Assam: Garo Hills (G. Mann, 1889). This specimen was included by Gamble (Ind. Bamb. 64) under *G. macrostachya.*

OXYTENANTHERA Munro.

Oxytenanthera nigrociliata Munro (Gamble Ind. Bambus. 69).

With this has been united *Bambusa auriculata* Kurz. The synonymy and description, therefore, has to be changed.

O. nigrociliata Munro in Trans. Linn. Soc. 26 (1866) 128. Bedd. Fl. Sylv. CCXXXIII; Gamble Ind. Bambus. (1896) 69; pl. 60, in Fl. Brit. Ind. VII, 401; Brandis Ind. Trees (1911) 674. E. G. Camus Bambusées (1913) 145; Haines Bot. Bih. & Or. (1924) 951. *Bambusa nigrociliata* Büse in Pl. Jungh. I, 389; Miquel Fl. Ind. Bat. III, 416; Walpers Ann. IV. 1045.—*B. Bitung* Hassk. Pl. Jav. Rar. 42, XXXIX.—*B. gracilis* Wall. Cat. 5033.—*B. auriculata* Kurz in Journ. As Soc. Beng. 39 (1870) 86; Gamble Ind. Bamb. (1896) 55. pl. 49.—*Giganiochloa auriculata* Kurz For. Fl. Burma II, 557.—*G. nigrociliata* Kurz Ind. Forester I, 345.—*G. andamanica* Kurz For. Fl. Burma II, 556.—*Oxytenanthera auriculata* Prain Beng. Plants 1234.

Vern. names : Kalia (Beng.); Talagu-wa (Burm.)

Description in Brandis Ind. Trees 674.

Distribution : Garo Hills, Sylhet, Chittagong, Lower Pegu, Tenasserim, Andamans, in the semi-deciduous forest and on banks and streams forming the lower fringe of the evergreen forest, Nicobars, Singapore (ex Brandis).

Oxytenanthera monostigma Bedd.—The specific name has to cede to the specific name of *Bambusa Ritcheyi* Munro as is evident from the following synonymy :—

Oxytenanthera Ritcheyi nov. comb.—Bambusa Ritcheyi Munro in Trans. Linn. Soc. 26 (1868) 113.—*Oxytenanthera monostigma* Bedd. For. Man. in Fl. Sylv. (1873) CCXXXIII, *et* Ic. Pl. Ind. Or. (1874) 56, t. 234; Gamble Ind. Bambus. (1896) 74, t. 65; Brandis Ind. Trees (1911) 674; Talbot For. Fl. Bomb. II (1911) 571; Camus Bambusèes (1913) 148; Troup Silvic. Ind. Trees III (1921) 1006.—*Schizostachyum hindostanicum* Kurz in Proc. As. Soc. Beng. 52, II (1873) 252.

Oxytenanthera Lacei Gamble in Kew Bull. (1910) 385; E. G. Camus Bambusées (1913) 148.

An erect shrub. Culms green or green-glaucescent, fistular, laxly fasciculate at the base, leaf-bearing branches hard, the last not fistular, flowering branches fistular or solid, terete. Culm-sheaths 20-30 cm. long, 15-20 cm. broad, at the base 4·4-6 cm. broad, straw-coloured at the apex, conspicuously striate, densely covered on the back in the upper part with blackish spinules; blade subulate-lanceolate, reflexed, 10-30 cm. long. at the base slightly contracted and there provided with 2 short, plicate fimbriate auricles; ligule about 5 mm. long, long-fimbriate at the mouth. Leaves thin, pale, on slender, geniculate, fasciculate branches which are arranged alternately on branches arising from the sides of the nodes; sheaths straw-coloured, striate, provided on the back with white spinules, having at the mouth long deciduous auricles which are sparingly long-fimbriate; blade 10-20 cm. long, 10-20 mm. broad, very scabrous above, pubescent beneath, margins scabrous, very acuminate at the apex,

subcordate at the base, 5 pairs of nerves, conspicuous beneath; ligule short, dentate, membranous. Flowers on flower-bearing culms forming glomeruli at the nodes of branches 20-40 cm. long which are alternately fasciculated at the nodes; glomeruli about 2 cm. diam., bearing 10-12 fertile spikelets with many smaller sterile ones and paleaceous bracts; spikelets 5-7 mm. long, quite glabrous supported at the base by 1-3 small bracts; empty glumes 2-3, ovate, mucronate, lower 3 mm. long, upper 4-5 mm.; fertile flowers 2; floral glumes ovate, long-mucronate, of the lower flower 6 mm. long, of the upper 8 mm.; pale of the lower flower 2-keeled, keels ciliate, marginate at the apex, 5-nerved, of the upper flower convolute, glabrous, apiculate. Stamens purple, the younger ones subsessile, free, the older ones united into a long exserted tube; anthers linear, mucronate at the apex. Ovary ovate-lanceolate, attenuate into a slender, pubescent style. Caryopsis unknown.

Related to *O. Thwaitesii* Munro, but scarcely scandent, with 2-flowered spikelets, shorter and less conspicuously auricled culm-sheaths, and thinner leaves.

Distribution: Burma: Thatone Distr.; E. of Salwen river, Hlaingbwe Forest Reserve and Melaung (J. H. Lace, 4578 4584).

SPECIES DUBIA.

Oxytenanthera densa E. G. Camus Bambusées (1903) pl. 91, f. c. In the text (p. 147) Camus is doubtful whether he should call his plant *O. Thwaitesii* var. *densa* or make a new species of it. His diagnosis is very short:

Glomeruli of flowers very close to each other. Spikelets numerous. Lower glume long-ciliate on the edges, and the nerves marked only at the apex.

No definite locality given, except that it is put under *O. Thwaitesii* which is a native of India and Cambodia.

DENDROCALAMUS Nees.

Dendrocalamus strictus Nees (Gamble Ind. Bambus. 78).—Add synonyms: *Bambusa glomerata* ex Munro in Trans. Linn. Soc.

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26(1 68) 147.—*B. hexandra* ex Munro l. c.—*Nastus strictus* Sm. in Rees Cycl. XXIV, No. 2 (*excl. syn. Loureiro*).

Gamble has united *D. sericeus* Munro with *D. strictus* under the varietal name:

Var. *sericea* Gamble Man. Ind. Timb. (1902) 751; Brandis Ind. Trees (1911) 676; Haines Bot. Bih. & Or. (1924) 947.—*Dendrocalamns sericeus* Munro in Trans. Linn. Soc. 26, 148; Gamble Ind. Bambus. (1896) 81, pl. 70, in Hook. Fl. Brit. Ind. VII, 404; Prain Beng. Pl. 1235; E. G. Camus Bambusées (1913) 153.

Munro, already, remarked that *D. sericeus* has very few definite characters to distinguish it from *D. strictus*. The appearance however is distinct on account of the spreading silky pubescence on the spikelets. Gamble considers the blunt anther-tips, more pointed paleae and less depressed ovary the best characters. But even these have not induced him to retain *D. sericeus* as a distinct species.

Distribution: Apparently endemic in Hazaribagh, summit of Parasnath, 4,000 ft. (Hooker, Thomsom, Kurz).

Gamble has another variety which is unknown to us:

Var. *Prainiana* Gamble Ind. Bambus. (1896) 80, t. 69, fig. A. in Hook. f. Fl. Brit. Ind. VII, 404; Gamble Man. Ind. Timb. (1902) 751. Spikelets smaller, flowers fewer, flowering glumes nearly glabrous.

Distribution: Great Cocos Island (Prain).

Dendrocalamus Hookeri Munro (Gamble Ind. Bambus. 83). Add synonyms: *Bambusa altissima* Hort.—*B. globifera* Griseb. in Goett. Nachr. (1868) 72.—*Melocanna* Roep. ex Trin. Clav. Agrost. 105, 397.

We unite with this species *D. Parishii* Munro under the varietal name:

Var. *Parishii*.—*D. Parishii* Munro in Trans. Linn. Soc. XXVI, 149; Gamble Ind. Bambus. (1896) 93, t. 82; E. G. Camus Bambusées (1913) 156.

Flowering glume glabrous; anthers bluntly acute.

Distribution: Punjab Himalaya (Parish).

• *Dendrocalamus patellaris* Gamble (Gamble Ind. Bambus. 86).

It is unfortunate that figs. 2 and 4-10 of pl. 75 have been drawn from Mann's very doubtful specimen. His was the only plant in flower at Gamble's disposal and he could not, therefore compare it with reliable material. About this plant Gamble says: "The flowering specimens now received are said by G. Mann to be doubtful, as he identifies them with *Dendrocalamus Hamiltonii*. But I find that they do not entirely agree with those of that common and well-known species, for the flowering glumes and paleae are very hairy inside, the anther tips are not nearly so long, there are lodicules occasionally present, and there is a terminal free rhachilla; so that I consider I am justified in assuming that Babu Sri Gopal Banerjee did get his leaves and his flowers off the same clump, and that until further specimens come to hand, those sent by him should be considered as belonging to this species." The fact that Mann's specimens are not *D. Hamiltonii* does not prove that the leaves and flowers of Mann's collector were taken from the same clump. The description and drawings of the flowers may, therefore, belong to some other species.

Dendrocalamus latiflorus Munro (Gamble Ind. Bambus. 113).—Add synonym *Bambusa latiflora* Kurz in Journ. As. Soc. Beng. 42 (1873) 250.

Dendrocalamus Hamiltonii Nees & Arn. (Gamble Ind. Bambus. 84.)—Add synonym : *D. maximus* Kuntze Rev. Gen. (1891) 773.

Dendrocalamus Messerii sp. nov.—Wabo é, Brandis Ind. Trees (1911) 677 (4).

[*Accedit ad D. Hamiltonii Nees and Arn., differt tamen cataphyllorum ligulis latioribus, serratis, florum glomerulis fere globosis, spiculis multo longioribus, floribus 8-10 infimis generatim masculis glumis minutissime ciliatis*].

A tufted bamboo. Culms 24-30 m. high., internodes 30-53 cm. long, 12·7 cm. diam. walls 18-25 mm. thick, branches all the way up, near the base thickly set and sometimes 6 m. long; conspicuous rings of arrested rootlets for 2·4-3 m. from the

ground; buds of undeveloped branches smaller and less prominent than in *D. Hamiltonii.* Culm-sheaths 45 cm. long; ligule 12 mm. broad, hairy; blade as long as the sheath, hairy. Leaves 20-23 by 2·5 cm., nerves 36 on ¼ in. Branches of inflorescence very hollow, up to 8 mm. diam. Flower-heads dense, nearly globose. Spikelets 18 mm. long, numerous. Glumes glabrous, edges minutely ciliate, the 2 lowest empty. Flowers 8-10, of which the lowest are usually male. Ovary broad, entirely hairy.

Vern. name: Wabo é (Burm.)

Loc. : Found in cool valleys and on the high evergreen Kachin hills in the Katha district (Messer .

The flowers, leaves and notes on this bamboo were sent to Brandis by the late Joseph Messer, and Brandis expressed the wish that it should be named after him.

Dendrocalamus pendulus Ridley in Journ. As. Soc. Straits 44 (1905) 210; E. G. Camus Bambusées (1913) 158 (*pendulinus per err.*).

Stems about 20 m. high, stout, 7·6 cm. diam., with long pendulous dark green branches, at the base glaucescent when young; internodes 23 cm. long, the lower ones with a ring of rootlets. Culm-sheaths 15-23 cm. long, provided with white short hairs; limb imperfect, straight, lanceolate, 10 cm. or more, with strong brown-red auricles provided with long white cilia. Leaves lanceolate-oblong, acuminate, thin, glabrous, 12·7-15 cm. long, 20 mm. broad, truncate at the base, on the edges slightly scabrous; petiole very short; sheaths finely pubescent, truncate at the apex, on the edges a little scabrous; ligule very short, smooth or with a few cilia. Inflorescence a compound panicle; glomerules subglobose, close together on the branches and supported at the base when young by large bracts surmounted by a small, imperfect limb. Spikelets 4 mm. long, shining, oblong, cylindric, numerous, 1-flowered. Glumes 2, ovate, glabrous. Lower flowering glume long-lanceolate, upper as long as the lower, 2-nerved, not carinate, lanceolate. Lodicules 0. Stamens 6; anthers oblong, finely apiculate, filaments free. Ovary conical short, hairy. Style simple, hairy.

• *Distribution:* Malay Peninsula: Selangor, Pahung Track (Ridley 8482) *Dendrocalamus hirtellus* Ridley in Journ. As. Soc Straits 73 (1916) 146.

A tall bamboo, about 12 m. long, 5 cm. diam. rather weak, walls thin, internodes long. Leaves broad, oblong, acuminate, with a long point, base broad rounded, glabrous above, softly pubescent beneath, 28 cm. long, 38 mm. wide; petiole thick, 2·5 mm. long, glabrous; ligule of few stiff bristles; sheath glabrous. Branches of panicle pendulous, 90 cm long. Spikelets in dense heads 12 mm. diam. and 38 mm. apart; bracts numerous, ovate acute, keeled. Glume I lanceolate; glume II similar, but longer, many nerved; III twice as long as I, mucronate; IV similar, longer. Pale shorter, lanceolate, 3-nerved, pale. Stamens 6; filaments free; anthers oblong, muticous, exserted. Style simple, shortly plumed.

Distribution: Malay Peninsula; Jehore, in forests at Genuang (Ridley).

SPECIES DUBIA.

?*Dendrocalamus Wabo* E. G. Camus Bambusées (1913) 154.—Wabo, Brandis Ind. Trees (1911) 679, (16).

Vern name: Wabo (Burm.)

Culm-sheaths 45 cm. long, thick, hard, shining within, thinly hairy outside. Leaves thin, grey, 15-23 by 2·5-3·8 cm., scabrid on both surfaces, nerves 20-24 on $\frac{1}{4}$ in.; petiole very short; sheath glabrous, edges ciliate. Heads of 10-20 spikelets, approximate, nearly confluent; spikelets 12-18 mm. long, nearly glabrous, tip hard, pungent; flowers 2-3, male, female and hermaphrodite. Pale long-ciliate at the keels, between the keels 2-5 nerves. Ovary and style densely hairy.

Loc.: Cultivated in villages, Southern Shan States, 1,500-2,000 ft. (ex Brandis).

PSEUDOSTACHYUM Munro.

SPECIES DUBIA.

?*Pseudostachyum Wakha* E. G. Camus Bambusées (1913) 162—Wakha, Brandis Ind. Trees (1911) 685.

Vern name: Wakha (Burm.)

Tufted, stems 10·5 m. long, weak, widely over-hanging, often breaking when without support; young shoots olive-brown just above and olive-grey just below the nodes; internodes 23 cm. long slightly swelling in the middle, 25-30 mm. diam., walls very thin, 1·6 mm. Culm-sheaths light buff-coloured, thin, closely clasping the stem, brown hairs outside in the lower portion; blade early deciduous, glabrous, finely ribbed, 7·6-8·9 cm. long. Leaves glabrous, light green, 25 by 3·8 cm., nerves 19-21 on $\frac{1}{4}$ in., transverse veins conspicuous, distant, mostly oblique; sheaths green with a few scattered brown hairs on the margin.—Similar to *Pseudostachyum polymorphum*. Munro, but reported to be tufted. (Brandis).

Distribution: Upper Burma: On Hmangin daung, 2,500 ft. gregarious in Taungya ponzo (Smales, March 1902.)

Teinostachyum Dullooa Gamble and *T. Helferi* Gamble to be put under the genus *Neohouzeaua* A. Camus.

We give the description of the genus:

Neohouzeaua A. Camus Bull. Mus. Nat. Hist. (1922) 100. Panicle elongate, branching, dense. Fertile spikelets 1-flowered; empty glumes 3-4, mucronate, often gemmiferous; fertile glume involute mucronate, subaristate; pale involute, elongate, keelless, bicuspidate at the apex. Stamens 6, filaments connate; anthers obtuse at the apex. Ovary oblong; style rigid, rather stout, elongate; stigmas 3, exserted.

This genus is nearly related to *Teinostachyum*, *Schizostachyum* and *Cephalostachyum*. Gamble gives the following rough working key to these genera:—

I. Pale 2-keeled, the two keels close together. ... *Cephalostachyum*.

II. Pale convolute, not keeled.

1. Spikelets with several flowers ... *Teinostachyum*.
2. Spikelets 1-flowered.
    - (*a*) Stamens monadelphous ... *Neohouzeaua*.
    - (*b*) Stamens free ... *Schizostachyum*

So far 5 species of *Neohouzeaua* have been described of which 4 occur in our area :

I. Anthers 9-10 mm. long.

1. Culms 6-9 m. high, about 2.5-7·5 cm. diam. ... ... *N. Dullooa.*

2. Culms 3-4·5 m. high, about 1·5 cm. diam. ... ... *N. tavoyana.*

II. Anthers 12-18 mm. long ... ... *N. Helferi.*

III. Anthers 4 mm. long ... ... *N. stricta.*

Neohouzeaua Dullooa A. Camus Bull. Mus. Nat. Hist. (1922) 100; Gamble in Kew Bull. (1923) 90, 91. *Teinostachyum Dullooa* Gamble Ind. Bambus. (1896) 101, pl. 89; Hook. f. Fl. Brit. Ind. VII, 411; Brandis Ind. Trees (1911) 679; E. G. Camus Bambusées (1913) 164, pl. 92, f. A.

Gamble (Kew Bull. l. c.) gives the following additions to his original diagnosis in his Ind. Bambuseae:—

"Spikelets usually 2 together, slender, bracteate at the base; empty glumes 2-4, small, mucronate; flowering glume oblong-lanceolate, mucronate, strigosely hirsute, about 8-10-nerved; pale convolute, glabrous except near the apex, 17-20 mm. long, biaristate, the base sometimes with a free terminal rhachilla often bearing rudiments of a terminal flower. Stamens 6, monadelphous, the anthers 9 mm. long, obtuse at apex, at length exserted. Ovary elongate, glabrous, stigmas 3, short, red.

Distribution: British Bhutan, 2,000 ft., Garo Hills, Assam, Sylhet, Cachar, Chittagong, Upper Burma, Tonkin. In Gamble's opinion perhaps even in the Philippines.

Neohouzeaua tavoyana Gamble in Kew Bull. (1923) 92.

Culms erect, 3-4·5 m. high, about 1·5 cm. diam., solid near the base. Culm-sheaths unknown. Leaves oblong, long setaceous-acuminate at the apex, subobtuse at the base, glabrous, 25-35 cm. long, 3-6 cm. broad, primary nerves 6-10 pairs; petiole stout, 1 cm. long; sheath glabrous, terete, produced below the petiole and provided at the lower side with a triangular horned callus; ligule 3-4 mm. long, lacerate at the apex. Spikelets 2 together

in heads aggregated at the nodes of the terminal panicle; lower heads subglobose, with many spikelets 2-3 cm. diam., the upper ones gradually smaller, the uppermost bearing 1-2 spikelets or none at all; spikelets 1-flowered, 2-2·5 cm. long, supported at the base by many bracts and provided at the base with 2-3 empty mucronate glumes. Flowering glume ovate-oblong, rather long-aristate at the apex, subglabrous on the back or slightly hirsute, 1-1·2 cm. long, minutely ciliate-glabrous on the margin; pale very narrow, much convolute, biaristate at the apex, 2-2·5 cm. long. Stamens 6, monadelphous; anther slender, about 10 mm. long, subobtuse at the apex. Lodicules none or 2 very short. Ovary very long; stigmas red. Caryopsis unknown.

Distribution: Burma: Sinyat hill in Tavoy at 1,000 ft. alt. (C. G. Rodgers 361T).

Neohouzeaua Helferi Gamble in Kew Bull. (1923) 91.—*Bambusa Helferi* Munro in Trans. Linn. Soc. XXVI, 114.—*Pseudostachyum Helferi* Kurz in Journ. As. Soc. Beng. 42 (1872) 253, For. Fl. Burma II, 568.—*Teinostachyum Helferi* Gamble in Ind. Bambus. (1896) 102, pl. 90, in Hook. f. Fl. Brit. Ind. VII, 411.

Here follow the additions to Gamble's description in the Ind. Bambuseæ made by Gamble himself in Kew Bull. l.c.

Heads of spikelets often large, even up to 5 cm. diam., though usually less. Spikelets usually 2 together, slender, prominently bracteate at the base; empty glumes usually 2, small, 5 and 8 mm. long, mucronate, the margins slightly strigosely hirsute; flowering glume ovate-lanceolate, long-mucronate, strigosely hirsute 12-25 mm. long, many-nerved; pale convolute, glabrous except at the tip, 3-4 mm. long, biaristate, the base sometimes with a free terminal rhachilla. Stamens 6, monadelphous, the anthers 12-18 mm. long, obtuse at apex, at length exerted. Ovary oblong, elongate, glabrous, stigmas 3, short, red. Pericarp of caryopsis leathery, oblong, including the beak over 5 cm. long.

Distribution: Assam: Garo, Khasia and Jaintia Hills, down to the Pegu Yoma and Martaban; occurs at elevations of 3,000-4,000 ft. with a rainfall of over 209 in. a year.

Neohouzeaua stricta Parker in Ind. For. LIV (1928) 97, pl. 9 Loosely tufted. Culms very straight, erect, 7-9 m. long, 5 cm. diam., dark green, internodes 60-100 cm. long, walls thin, nodes marked by a sharp ledge after the fall of the culm-sheaths; young culms covered with short harsh hairs. Culm-sheaths deciduous, about 22 cm. long, clothed on the back with brown irritating bristles and a little white powder; apex of sheath when spread flat produced on either side into broad triangular auricles which on the inner side are furnished with a row of stiff erect scabrid setae about 12 mm. long; ligule very short fringed with a row of similar but more slender setae; imperfect blade very narrowly linear-lanceolate, reflexed, about as long as the sheath. Leafy branches switchy, in dense half-whorls at the nodes. Leaves 18-28 by 3-4 cm. or smaller, scabrid above towards the lower edge, narrowed into a long twisted scabrid point, paler or slightly pubescent beneath, margins minutely scabrid, main lateral nerves about 7 on either side of the midrib, intermediate veins 5-8; petiole 5-10 mm. long; leaf-sheath grey-pubescent when young; callus with a fringe of minute white hairs, auricles with long setae; ligule short with a fringe of slender setae. Inflorescence a large panicle of leafless or sometimes leafy branches in dense half-whorls, rhachis smooth, slender, bearing the spikelets in few-flowered or dense usually closely approximate heads. Spikelets fertile and sterile mixed in about equal numbers, the fertile 15-16 mm. long, linear-cylindric, consisting of 3-4 small, ovate, mucronate glumes, increasing in size upwards, the uppermost usually bearing a very small, arrested spikelet followed by a joint of the rhachilla 1·5-2 mm. long, flowering glume 8-11 mm. long, convolute, many-nerved, microscopically pubescent, tipped with a mucro $\frac{1}{2}$-1 mm. long, pale similar to the flowering glume. 12-15mm. long, tipped with 2 scabrid mucros 2-3 mm. long. Stamens 6, filaments united in the tube; anthers 4 mm. long, obtuse. Ovary and style glabrous; style as long as the pale; stigmas 3, short plumose (Parker).

Nearly related to *N. mekongense* A. Camus, but the inflorescence is more slender and the spikelets smaller.

Distribution: Tavoy District (Parker 2404, 2408), Mergui District (Parker 2462).

CEPHALOSTACHYUM Munro.

Cephalostachyum malayense Ridley in Journ. As. Soc. Straits 57 (1911) 118.

Distribution: Malay Peninsula.

DINOCHLOA BÜSE.

Dinochloa montana Ridley in Journ. As. Soc. Straits 44 (1905) 210.

Densely tufted. Culms long, climbing, polished. Leaves lanceolate-acuminate, 20 cm. long, 2·5 cm. broad, glabrous, slightly scabrous at the apex, somewhat unequally attenuate into a short 3 mm. long petiole. Culm-sheaths polished, striate, provided at the mouth with a callus which is not ciliate, but very shortly pubescent. Rhachis of panicle long, pubescent, provided with groups of spikelets 6 cm. from each other. Spikelets 3-6 mm. long, straw-coloured, 1-flowered. Empty glumes 4, ovate, obtuse, strongly keeled, submucronate. Lower flowering glume lanceolate, finely mucronate, nerved; upper oblong, 2-nerved, not ciliate. Lodicules 6, spathulate, oblong, closely nerved, edges ciliate. Fruit oblong, with a beak finely pubescent, narrow at the base, longitudinally furrowed.

Distribution: Malay Peninsula: Penang Hills up to 3,300 ft. (Ridley 7061, 7265, 10171).

Dinochloa andamanica Kurz in Journ. As. Soc. Beng. 42 (1873) II, 253, For. Fl. Burma II, 570; Brandis Ind. Trees (1911) 681; Munro in Trans. Linn. Soc. 26 (1824) pl. V; E. G. Camus Bambusées (1913) 169.—*D. Tjankorreh* Büse var. *andamanica* Gamble Ind. Bambus. (1896) 112, t. 98, in Hook. f. Fl. Brit. Ind. VII, 414.

Culms single, green, glossy, up to 90 m. long, creeping along the ground and then rooting at the nodes, or climbing over the tallest trees. Branches geniculate, single, as long and as stout as the culms from which they arise; branchlets slender, numerous in whorls, hanging down with their dense foliage. Internodes

28-46 cm. long, 25 mm. diam., walls thin. Culm-sheaths green, less than ¼ the length of the internodes, as well as culms covered, while young, with a fugacious white bloom ; blade leafy, deciduous, nearly as broad as the sheath. Leaves 23-30 by 5-7·5 cm., nerves 18-24 on ¼ in., upper side polished ; ligule short, entire. Panicle terminal, narrow, often leafy, spikelets minute, glossy, straw-coloured. The other characters like those of *Dinochloa scandens* O. Kuntze. Fruit unknown.

"New main branches" according to Brandis, "develop annually, at first leafless, curved, tendril-like, later in the season covering themselves with a dense mass of foliage, which hangs down from the supporting trees and eventually smothers them. Where no large trees exist, this bamboo forms an impenetrable tangled mass, spreading over shrubs and saplings."

Distribution : Andamans, Nicobars.

Dinochloa scandens O. Kuntze Rev. Gen. Pl. (1891) 773; Gamble in Philipp. Journ. Sc. V (1910) 278; E. G. Camus Bambusées (1913) 169, pl. 59.—*D. Tjankorreh* Büse in Miq. Pl. Jungh. 388; Miq. Fl. Ind. Bat. III, 415; Munro in Trans. Linn. Soc. XXVI, 153; Kurz in Ind. Forester I, 352; Gamble Ind. Bambus. (1896) 112, in Hook. f. Fl. Brit. Ind. VII, 414.—*Bambusa scandens*, Blume ex Nees in Flora VII (1824) 291.—*Nastus Tjankorreh* Schultes Syst. VII, 1358; Kunth Enum. I, 340; Steud. Syn. 333.—*Chusquea amplipaniculata* Steud. Syn. 337; Miq. Fl. Ind. Bat. III, 415.

Very nearly related to *D. andamanica*, but is distinguished by smaller leaves and the nerves being closer together, 27-36 on ¼ in. and by the often long, fimbriate ligule.

Vern. names : Buta Akar (Perak), Tjankorreh (Java).

Description : Gamble Ind. Bambus. 112.

Distribution : Malay Peninsula : Moluccas, Minanao, Java, Borneo etc,. up to 3,500 ft.

SCHIZOSTACHYUM Nees.

Schizostachyum Rogersii Brandis in Ind. Trees (1913) 679; E. G. Camus Bambusées (1913) 178.

Culms tufted, weak, up to 9 m. high, to 19 mm. diam., overhanging or supported by trees, walls thin. Culm-sheaths much shorter than internodes, thin, 7·6-10 cm. long, hairs very fugacious, base 5-6·3 cm. broad, tapering to 2 cm., with 2 small auricles at the apex, blade narrow, reflexed as long as the sheath. Leaves 18-23 by 2·5—3·8 cm, on the underside long, fine hairs, nerves 21 on ¼ in., transverse veins prominent, oblique and bent. Inflorescence a long spike, terminating leafy branchlets, with distant half-whorls of spikelets supported by bracts, which are often furnished with a blade. Spikelets 1—flowered, glabrous, the fertile 12 mm. long, the sterile shorter. Empty glumes 2-4; pale convolute, minutely 2-dentate, keels indistinct. Lodicules 3, unequal. Anthers yellow, obtuse, 4 mm. long. Ovary glabrous, continued into a thick cylindric hollow style, terminated by 3 long plumose stigmas. Caryopsis ellipsoid-cylindric, crowned by the long, persistent style; endosperm farinaceous.

There is some resemblance between this and *S. chilianthum* Kurz.

Distribution: Andamans (G. Rogers).

Schizostachyum elegans Ridley in Journ. As. Soc. Straits 73 (1916) 146.

Stems slender, 2·5 cm. diam., walls rather thick; internodes long and weak; branches slender, whorled. Leaves thin, lanceolate, acuminate, pubescent beneath, margins denticulate, base narrowed to the very short petiole, 15 cm. long, 2 cm. wide; ligule of few rather long bristles; sheath hairy. Panicles graceful, 38 cm. long, slightly geniculate; branches 5-10 cm. long. Spikelets 6 mm. long, light green, 4 or 5 in a fascicle, with several ovate bracts at base, fascicles little over 6 mm. apart. Glume I ovate; II longer, lanceolate, shortly mucronate; III still longer, mucronate; IV similar but longer. Pale a little shorter, lanceolate, not keeled, glume-like, but thinner. Stamens 6; filaments free; anthers exserted, oblong, obtuse, violet. Ovary conic, stipitate, subtriquetrous; style simple; grain obliquely blunt, conic, stipitate.

Distribution: Malay Peninsula: Lankawi Islands (Kedah) (Ridley).

Schizostachyum aciculare Gamble (Gamble Bambus. 117). Add synonym: *S. aviculare* Auct. in Just Jahresb. XXIV, II, 391, *sphalm.*

Schizostachyum Zollingeri Steud. Syn. 332; Balansa in Morot Journ. Bot. (1890) 31; E. G. Camus Bambusées (1913) 173, pl. 98, f. C.—*S. Blumei* Miq. Fl. Ind. Bat. III, 424 (*non* Nees).—*Melocanna Zollingeri* Kurz ex Munro in Trans. Linn. Soc. XXV (1866) 133; Ridley Mat. Fl. Mal. Pen. 195.

Culms subfrutescent, internodes glabrous, or scabrous towards the apex without spines, glabrous at the nodes or rarely hirsute, with fasciculate branches, sometimes with floriferous branches, the uppermost often with leaves and ending in spikes. Culm-sheath slightly coriaceous, sometimes rough to the touch, ciliate on the edges, rarely auricled on the sides, the mouth often fimbriate with mostly caducous hairs. Leaves 15-30 cm. by 20-40 mm., often plicate, secondary nerves rather strong, 6-12 pairs, lanceolate, attenuate at the base into a short petiole, long acuminate, glaucescent, scabrous on the edges, glabrous on both sides, sometimes hirsute beneath or slightly rough to the touch. Inflorescence a terminal subspiciform or interrupted panicle, composed of fascicled spikes, the lower fascicles sometimes proliferous. Fertile spikelet 10-18 mm. long or longer, often 4-flowered, the 2 lower flowers sterile, the 3rd 2-paleaceous, hermaphrodite, the 4th more or less rudimentary. Lower glume of the hermaphrodite flower with strong nerves; upper shortly 2-keeled, finely ciliate towards the apex. Lodicules 3, oblong, fimbriate. Stamens 6 (rarely 3, Steudel); anthers obtuse. Style long. Stigmas 3. Ovary long-beaked, puberulous.

Distribution: Malay Peninsula: Singapore, Bukit Timah Road (Ridley 6116); Yeo Chu Kang; Muar; Bukit Muar (Fielding 4420); Johor (Ridley 9177) etc.—Tonkin, Laos.

Schizostachyum insulare Ridley in Journ. As. Soc. Straits 61 (1912) 64.

Stems about 7·6 cm. diam., 6-12 m. high. Leaves lanceolate—accuminate with a long point; margins of the denticulate base narrowed cuneate, 30 cm. long, 38 mm. wide, petiole channelled, 6 mm. long. Sheaths ribbed, ligule of long bristles 6 mm. long.

Inflorescence over 30 cm. long of 5 or 6 spikelets crowded with tufts; tufts 2·5 cm. apart, with lanceolate bracts at the base, 1·2 cm. long and 6 mm. wide. Spikelets 2·5 cm. long. Empty glumes at base 2:—I ovate, keeled, mucronate, 3 mm.; II lanceolate, keeled, mucronate, margins at the top bristly, 6 mm.; III elongate, lanceolate, mucronate, very bristly at tip; IV elongate narrow-lanceolate, tip slightly bristly. Pale lanceolate, convolute. Filaments slender, connate. Anthers 4, linear, long, not penicillate, Ovary narrow, subcylindric. Lodicules oblong with a rounded tip, brown, pubescent.—Near *S. latifolium*.

Distribution: Malay Peninsula: Pulau Rawi (Ridley).

Schizostachyum dumosum Ridley in Journ. As. Soc. Straits 61 (1912) 64.

A slender erect bamboo, hollow; stems 1·8-2·1 m. or longer, 3 mm. or more diam.; internodes over 15 cm. long, smooth. Leaves lanceolate-acuminate, base broad, slightly narrowed at the extreme base, 15 cm. long, 18-25 mm. broad, margins scabrid; petiole 2·5 mm. long; ligule none, a black edge to the sheath only marking it. Inflorescence terminal, 60 cm. long, slender, with tufts of slender branches, 15 cm. long or less from the nodes. Spikelets in tufts about 12 mm. long, crowded. Bracts papery, ovate, about 3 mm. long. Spikelet 6 mm. long, 2·5 mm. diam., acuminate. Glume I ovate, minutely cuspidate, 4-ribbed; II ovate-lanceolate, 6-ribbed, half as long again; III longer, lanceolate; IV elongate-lanceolate, distinctly cuspidate. Flowering glume 1, paleaceous. Stamens 3; filaments connate; anthers brown, dehiscing only at the top, ovary with a long, conic, acuminate beak, hairy. Style filiform, red-brown. Stigmas purple, feathery, fairly long.

Distribution: Malay Peninsula: Rawi Island (Ridley).

Schizostachyum grande Ridley in Journ. As. Soc. Straits 82 (1920) 204.

Culms 20 m. high, 8 cm. diam.; internodes 60-90 cm. long, walls thin. Sheaths over 30 cm. long, covered with white hairs in fascicles between the nerves. Leaves very stiff, almost coriaceous oblong with a somewhat abrupt point; base round, narrowed very

shortly to the broad petiole, blades smooth, midrib very prominent, edge very minutely serrulate or smooth, nerves 28; petiole 12 cm. long, about 4 mm. wide; sheaths flattened; ligule rather large, not bristly. Panicle 30 cm. long. Bracts short, ovate. Spikelets crowded in tufts, 12-25 mm. apart, very slender, 12 mm. long; glumes lanceolate, mucronate, strongly ribbed, glabrous. Pale lanceolate, acuminate. Lodicules 2, oblong, lanceolate, tip white, ciliate. Anthers shortly apiculate.

Distribution: Malay Peninsula: Selangor, Semangkok Pass (Ridley 8457, 12043); (Machado 11591); (Curtis 3475); Ginting Bidai (Ridley 7787).

"This very fine bamboo forms the greater part of the bamboo forest at the Semangkok Pass. Gamble in Herb. Kew suggested it was his *S. latifolium* based on a plant from Kota Glanggi, a much smaller plant with ciliate glumes. Another plant which he has also written up in Herb. Kew as *S. latifolia* is certainly *S. longispiculata*, Kurz, a Javanese bamboo with very slender stems and much smaller softer leaves. It occurs at Pahang, Kuala Lipis (Machado 11592 and 11593); Selangor, Ginting Bidai (Ridley 7788); Dindings (Ridley 1032 and 8389)." (Ridley).

Schizostachyum subcordatum Ridley in Journ. As. Soc. Straits 82 (1920) 204.

Branches slender. Leaves lanceolate, acuminate; base broad, subcordate 12-15 cm. long, 18 mm. wide, midrib slender; petiole very short; ligule very short, no bristles. Panicles simple, numerous in whorls or terminal on leafy branches, 7·5-10 cm. long of 7 or 8 clusters of spikelets crowded towards the tip. Bracts ovate, mucronate with 3 ribs from the tip, polished; spikelets very short, 4 mm. long; glumes lanceolate, smooth; pale, thin, lanceolate, acute. Lodicules 0.

"Allied to *S. chilianthum* but differing notably in the narrow lanceolate nearly cordate auricled leaves, and the very small crowded spikelets, which on one spike are crowded into a dense mass 1 in. long. The whole plant appears to be perfectly glabrous." (Ridley).

Distribution : Malay Peninsula : Selangor, Semangkok Pass (Ridley 8482).

MELOCANNA TRIN.

Melocanna bambusoides Trin. (Gamble Bambus. 118). Add synonym : *M. baccifera* Skeels in U. S. Dept. Agr. Bur. Pl. Ind. Bull. 223 (1911) 50.

SPECIES DUBIÆ.

Melocanna sp. Brandis Ind. Trees (1911) 683 (3).

Culms solitary, distant, 6 m. high, unbranched below, sharp thorns on the lower nodes, 2·5-7·6 cm. long. Leaves similar to those of *M. bambusoides* Trin., 25 by 2·5-3 cm. narrowed into a long tip with long stiff hairs, nerves 24-30 on ¼ in., inner edge closely set with fine hairs on a colourless band.

Distribution: On the high road from Manipur town to Silchar, near the Irang river (Clarke in 1885). "There was a large pure forest of this bamboo, and he (Clarke) was in that forest for two days' march. The species has not been found again, since 1885 the forest along that road has been jhummed twice by the Nagas." (Brandis).

Melocanna sp.—Tabindaing, Brandis Ind. Trees (1911) 683 (4).

Vern. name : Tabindaing (Burm.)

Branches of rhizome 10 cm. diam., bending upwards and terminating in a culm nearly naked in the lower part ; internodes, striped 63-76 cm. long, 6·2 cm. diameter ; nodes hardly swollen, walls 6 mm. Culm-sheaths sometimes green, very thick, persistent, 20-25·4 cm. long, truncate ; blade reflexed, long, striate. 7·6 cm. broad at base, decurrent on both sides into a wavy fringed band, 12-16 mm. broad. Leaves 37-50 by 5-7 cm., pale beneath and sometimes minutely velvety, transverse veins visible, nerves 20-25 on ¼ in. ; ligule prominent.

"From *M. bambusoides* this species is distinguished by the longer culm-sheaths, tightly appressed to the internodes, blade broad not convolute, decurrent into a broad wavy band, tip of leaf without a brush, sheath quite glabrous, ligule large. From

the single-stemmed bamboos enumerated under *Gigantochloa macrostachya* it differs by larger leaves and the distant longitudinal nerves." (Brandis).

Distribution : Burma: Attaran (Manson in 1903).

OCHLANDRA Thw.

Ochlandra Talboti Brandis Ind. Trees (1911) 684; Talbot For. Fl. Bomb. II (1911) 572; Cooke Fl. Bombay II, 1050; E.G. Camus Bambusées (1913) 181.—*O. Rheedei* var. *sivagiriana* Talb. Trees of Bomb. 348 (*non* Gamble).—*O. stridula* Woodr. in Journ. Bomb. Nat. Hist. Soc. 13 (1901) 442 (*non* Thw.)

Vern. names : Huda (Mar.), Wontenulgi (Kan.)

Culms numerous in dense clumps, slender, 6-18 mm. diam. hollow, sometimes scandent, nodes thickened, shining, glabrous. Leaves glabrous, pale, lanceolate, long-acuminate, 20-30 by 3·8-6·3 cm., petiole 6 mm. long; sheath glabrous, at mouth early deciduous, nerves 30-36 on $\frac{1}{4}$ in. Spikelets in half-whorls on a terminal erect spike, 10-20 cm. long, glabrous or nearly so, a few soft hairs at the tips of the glumes; fertile spikelets few, 3 cm. long. Empty glumes 3-6; lodicules 6, linear, veined. Stamens 25-40; anthers 12 mm. long, connective minutely apiculate filaments long, slender. Fruit ovoid, 50-76 by 8 mm., narrowed into a long beak, supported by 4 persistent glumes.

Distribution: N. Kanara: In monsoon and rain-forest often along the banks of rivers and nallahs on the Southern Ghats, very common near Dodmune and Nilkund and generally throughout the Coompta and Honawar talukas (Talbot).

Ochlandra Sivagiriana E. G. Camus Bambusées (1913) 181 pl. 99. *O. Rheedei* var. *sivagiriana* Gamble Ind. Bambus. (1896) 122, pl. 108 (*non* Talbot).

Leaves very large, attenuate at the base into a petiole about 2 mm. long, cuspidate at the apex. Spikelets much larger than in *O. Rheedei*. Stamens very numerous, 50-60, the rest as in *O. Kheedei*.

Distribution : Sivagri Hills, 4,000-4,500 ft., Pulney Hills.

SPECIES DUBIA.

Ochlandra setigera Gamble Ind. Bambus. (1896) 128, pl. 115 in Hook. f. Fl. Brit. Ind. VII, 420; Brandis Ind. Trees (1911) 685.

Position doubtful, may even be a new genus. Has been put under *Ochlandra* on account of its appearance (Gamble).

SPECIES NOBIS PLANE IGNOTAE.

Arundinaria utilis Cleghorn in Journ. Agr. Soc. of India XII (1865) 388.—Doubtfully put under *A. falcata* Nees by Gamble.

Arundinaria nitida Hort. Kew. ex Kew Bull. App. II (1894) 33 (*non* Mitf.). *Nomen tantum.*

Bambusa agrestis Poir. Encycl. VIII, 704.—According to Ind. Kew a species of Ind. Or. and Cochin-China; but it has not been found in India.

Bambusa andamanica Kurz in Journ. As. Soc. Beng. 39 (1870) 88. *Quid est ?* Not mentioned by Gamble and Camus.

Bambusa aristata Lodd. & Lindl. in Penny Cyc. III (1835) 357. *Quid ?*

Gigantochloa wallichiana Kurz in Teijsm. & Binn. Cat. Hort. Bogor. (1866) 20. *Quid est ?*

Melocanna travancorica F. Muell. Sel. Pl. Industr. Cult. 129. *Quid est ?*

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(ADDITIONAL NOTES BY R. N. PARKER, F.C.H., FOREST BOTANIST, DEHRA DUN.)

Gigantochloa. As pointed out by Parkinson (in lit.) Kurz and following him Gamble and others have described flowering specimens of one species and the leaves and culm-sheaths of another under the name *Gigantochloa macrostachya*. Kurz's description of the flowers is quite recognizable and definite whereas his description of the leaves and culm-sheaths might refer to several species of *Bambusa*. It seems therefore reasonable to take *Gigantochloa macrostachya*, Kurz to be the species represented by his flowering specimens. If Gamble's description of the culm-sheaths and leaves of the plant he calls *Bambusa affinis* are substituted for the descriptions he gives for these organs under *Gigantochloa macrostachya* the rest of the description applies. All Gamble's statements regarding distribution and vernacular names are definitely incorrect or doubtful except for Brandis' flowering specimens from the Sittang hills.

We have 5 separate gatherings of *Gigantochloa macrostachya*, Kurz showing flowers, leaves and culm-sheaths and as these all agree there can be no doubt of the incorrectness of Gamble's plate. The distribution and vernacular names as shown by specimens that are not doubtful is as follows :—

West Salween—*Wapyu.* South Tenasserim—*Wa byauk.* Amherst; Ogilvie, *Wapyu.* Parkinson 5204 *Wamaing*, (Karen). Parkinson 5093 *Wa maing Wa may* (Karen). Parkinson 5084 *Wapyu* (Burm.) *Wa maing* (Karen).

Tavoy Sein Gyi *yahpu.* Parker 2268 *Wa byaw.*

In view of the mistake in the culm-sheaths of *Gigantochloa macrotachya* it is obvious that the bamboos mentioned by Brandis (Indian Trees, p. 672) in so far as the identification is based on culm-sheaths have nothing in common with *Gigantochloa macrostachya.*

• Good specimens in flower are easily recognized but, as often happens, when all the larger and fertile spikelets drop off and the specimens only show the small imperfectly developed spieklets this species is very easily confused with *Oxytenanthera nigrociliata*.

Oxytenanthera Lacei, Gamble. Tavoy *Parker* 2227. This bamboo is exceedingly like *Dendrocalamus membranaceus* Munro, and I collected my No. 2227 as being that species. The monadelphous stamens is the only distinction between these two. This character of free or monadelphous stamens though used for generic distinctions in bamboos is often very difficult to observe and I have long suspected its value. Gamble under *Bambusa lineata* Munro says "filaments often apparently monadelphous but separable". This is a condition I have repeatedly met with in bamboos and I am inclined to think that *Dendrocalamus membranaceous* and *Oxytenanhera Lacei* are one and the same species. Fresh flowering specimens of *Dendrocalamus membranaceus* should be examined in large numbers to see if the filaments are always free.

Oxytenanthera Hosseusii Pilger in Fedde Rep. Sp. Nov. III (1906) p. 116. Indo-China, Siam, Burma, Amherst Mg. Soe Min, 436.

Dendrocalamus. It is perhaps not generally realized that in the absence of the caryopsis it is not possible to distinguish *Bambusa* and *Dendrocalamus* with certainty. It is therefore possible that some of the species described by Gamble under *Dendrocalamus* are in reality species of *Bambusa*, e.g., *D. calostachyus*, Kurz.

A DESTRUCTIVE PARASITE ON THE HIMALAYAN BLUE PINE.

By R. Maclagan Gorrie, I.F.S.

Why the smallest dicotyledonous plant should be saddled with a name like *Arceuthobium minutissimum* Hook, is hard to understand, but this tiny plant certainly fulfils the Scots standard

of "guid gear in little bulk" in the efficiency of its methods. This parasite on the blue pine (*Pinus excelsa*) is noted by Parker in his "Forest Flora of the Punjab" as being responsible for killing off large numbers of the blue pine in Pangi and Lahaul at 10,000—11,000 feet. This feature of the early death of the blue pine in the higher levels of its distribution in the Sutlej valley has also been remarked on by various forest officers in Bashahr, but I do not think that its real cause was recognised until Mr. Parker himself re-visited Bashahr in 1928 and called attention to the widespread damage which was taking place.

The blue pine distribution in the Bashahr State forests of the Sutlej valley is governed chiefly by the extent of the monsoon in the outer hills and by the distribution of long-lying snow in the inner hills where the monsoon is ineffective. In the outer hills this pine occurs as low as 5,000 feet, although it does not occur in Kangra and appears to avoid the areas of heaviest monsoon rainfall in the Simla Hills. It covers enormous areas in the Pabar basin above Kotkhai, but on the steeper gradients of the adjoining Sutlej basin it is restricted to the sunny well-drained ridges, and particularly above 8,000 feet it leaves the damper areas to spruce and broad-leaved species. Further up the Sutlej valley where the effect of the monsoon weakens, the blue pine retreats uphill. At Kilba where the rainfall is 32", of which about half is winter snowfall, the blue pine comes in much higher up than the deodar, the two forming a mixed crop above 9,000 feet while below this the deodar occurs pure, and above 10,000 feet the blue pine forms a mixture with the spruce.

In Chini and Kailas, where the rainfall is less than at Kilba, and with probably three-quarters of the total in the form of winter snow, the blue pine does not generally occur much below 10,000 feet, and as the arid zone is approached it is more and more restricted to places where long-lying patches of snow provide a supply of surface moisture sufficiently late in the summer to assist germination, and in such places it occurs as high as 12,500 feet along with occasional patches of juniper scrub.

• • •

The *Arceuthobium* attack is most in evidence in this semi-arid tract. In many parts of this inner dry zone the blue pine has been decimated by it, and the alpine pasture lands are festooned with the dead and dying stems of trees barely past the pole stage. The effect is most noticeable on ground where the pine is not quite happy, and the prolific regeneration of the pine frequently brings it on to ground where it could not be expected to reach maturity, even apart from the effects of the *Arceuthobium*. In anything approaching its optimum conditions the *kail* is so virile that it recovers from the attack and produces timber crops apparently unaffected by the continued presence of the parasite, but where other factors are not favourable, as for instance on hot shallow soil, rocky boulder screes, or on boulder moraines from old glaciers and rock avalanches, the pine is unable to survive the attack and dies off.

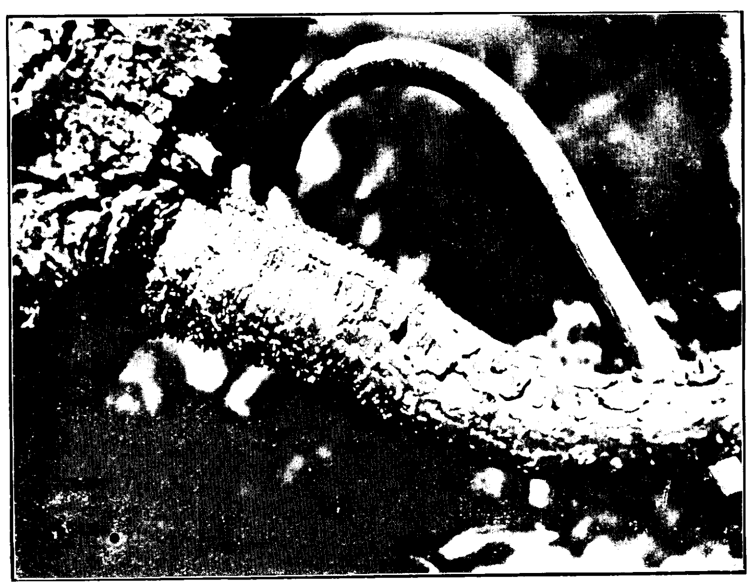
Towards the monsoon zone the *Arceuthobium* continues to keep to the upper level of the *kail*, even when the host tree occurs at a much lower level. In the Taranda and Pandrabis ranges it is difficult to find traces of any attack below a contour of about 9,200 feet in the blue pine zone, and it is seldom of obvious importance below 10,000 feet except on really bad ground. Above this it is almost as virulent in its effect as in the dry zone, but the devastation caused amongst the blue pine is masked by a more general mixture of spruce.

The parasite appears as a number of tiny green pustules which grow out through the thin bark of its host, rather like a miniature mistletoe; it is in fact a mistletoe, as it belongs to the Loranthaceæ. These protrusions are annual, producing separate minute male and female flowers, and eventually a tiny greenish-yellow berry on the end of a minute jointed stalk. This ripens during the summer and most of the smaller forest birds such as tits and finches can constantly be seen clinging to the *kail* branches at all angles and gobbling the fruits. There is thus no difficulty in deciding upon the method of infection, and the voided seeds can germinate on, and pierce, any moderately thin piece of *kail* bark on which they are deposited by these birds.

Infection commonly takes place on young saplings 6 to 10 feet high, or rather this is the age at which the parasite makes its presence felt, so possibly infection occurs even in the seedling stage of the pine's growth. Plate 31 shows the swollen appearance of the main stem of a badly attacked sapling, whose normal girth should be as shown at the top of the picture. The branches are also very swollen, particularly near their junction with the stem. Distortion of the main stem is not usual at this stage, but is frequently to be seen on older trees which have survived an attack in the sapling stage and are otherwise fairly healthy trees. Obviously the initial infection occurs through the *Arceuthobium* seed lodging and rooting itself in thin bark, but once established, the flower bearing green sheaths can force their way through quite thick and mature bark, as is shown in the photo of an older stem and badly infected branch in the photo.

Another feature which does not usually appear in the earlier stages of the attack is a form of "witches' broom", which is very typical of the dry zone *kail* in old trees. The attack apparently stimulates the growth of all dormant buds and immense masses of misshapen and crowded twigs develop and eventually die off, forming the ungainly out-growths shown in the plate. This "witches' broom" effect is also found in the sapling stage of the *kail* when a fastigiate bush is produced. Such cases are fortunately not very frequent and are mostly confined to hot shallow soil where the *kail* could hardly be expected to develop happily, but in these cases the bush inevitably dies off, and the parasite dies with it.

Restricted as it is to the higher forests adjoining the summer pasture grounds, and to the protective forest belt of the arid and semi-arid inner hills, this disease is not likely to affect the immediate yield of commercial forests. Its effect is much more serious in reducing the protective value of the forest belt which intervenes between the eternal snows above and the desolate stretches of naked cliff and sparsely clothed screes below in the farther reaches of the Sutlej valley. Now that the Sutlej canals are a *fait accompli* it is more than ever essential to preserve what-



Destructive Parasite on the Himalayan Blue Pine.

ever forest growth is left in face of the continual inroads of *nautor* cultivation and the timber demands of right-holders which can only with difficulty be met without over-felling these forests.

Although we have no records of the extent of this disease in the past, it would appear to be to a certain extent endemic. At least from the older villagers' accounts I gather that the high-level *kail* has always been affected in this way and that these early deaths have always been known to occur. It is thus no fresh epidemic which we have to deal with, but the cumulative effect is obviously serious and there is every prospect of the blue pine being exterminated from many parts of the upper valley. In the moister forests of the lower valley the mixture of spruce, and in a few places deodar, will doubtless increase and occupy any blanks caused by the death of the blue pine, but unfortunately in the drier zone where the loss is heaviest there is no species at all likely to replace the diminishing blue pine. In some of the worst affected areas such as the forest belt of the Baspa valley below the Rupin and Buran Passes the heavy lopping of blue pine branches has hastened the destruction of the forest canopy where the disease is present, and the high-level farm cultivation, which has previously been carried on behind a sheltering screen of forest, is almost certain to deteriorate owing to undue exposure.

In the absence of any alternative tree species except occasional patches of juniper scrub, it is difficult to see any way of tackling the problem, short of exterminating the birds which spread the *Arceuthobium* !!! Strict closure to grazing would probably help in increasing the regeneration of the *kail* and in improving the soil cover, but in an Indian State where grazing rights are sacrosanct, this is almost as fantastic a suggestion as the previous one. There appears to be nothing for it but to "grin and bear it" until belated shouts from disillusioned canal men down on the plains call public attention to the catchment area of their unruly Sutlej, and the need for conserving its soil covering

REVIEWS.

THE FLOWERING PLANTS OF MADRAS CITY AND ITS IMMEDIATE NEIGHBOURHOOD. BULLETIN OF THE MADRAS GOVERNMENT MUSEUM, NATURAL HISTORY SECTION VOL. II

BY P. V. MAYURANATHAN.

This publication has been exceptionally well turned out for a Government Press but the plates are rather disappointing. Only one species of Cyperus is figured but had several been figured in the same style they would have been of little if any assistance in identifying the species.

As is to be expected in a flora of this nature there is an unusual number of introduced species particularly tropical American Compositæ and cultivated plants and in the latter class it must have been difficult to decide what to nclude and what to omit.

The spelling "Ipomaea" is used by Gamble in his Manual of Indian Timbers and Flora of Madras but elsewhere "Ipomoea" seems to be universal. If a future edition is issued *Terminalia*

Cattappa, and *Excaecaria* as well as a few more obvious misprints might be corrected as also the use of *Rhamnus* with both masculine and feminine specific names. To call *Odina Wodier* the Indian ash tree is objectionable as there are several species of *Fraxinus* in India and *Odina Wodier* does not particulary resemble an ash.

This work will doubtless be of much interest to persons living in Madras and should do much to stimulate an interest in the local flora.

The price is Rs. 8 and the book is obtainable from the Superintendent, Government Press, Madras.

R. N. P.

EXTRACTS.

THE FORESTS OF THE ANDAMAN ISLANDS.

The forests of the Andaman Islands were first reported on in 1866 by Mr. S. Kurz, Curator of the Herbarium of the Royal Botanic Gardens, Calcutta. At the instance of the Government of India, Mr. Kurz was deputed to explore these forests by Dr. Anderson, at the time Superintendent of the gardens. Whilst recommending, in his interesting report, a certain amount of forest clearing for the extension of agriculture, and in order to render the settlement healthier, Kurz stated that, in his opinion, it was of the highest importance that the forests should be preserved, as they should have a considerable future value. Since the publication of this report the management of the forests of the islands has had a somewhat chequered career, but throughout a recognition of their value has persisted. The report on a recent "Tour of Inspection of the Forests of the Andamans" by Mr. A. Rodger, Inspector-General of Forests to the Government of India, should prove interesting reading to all having a knowledge of these interesting islands and their arborescent flora, so far as it is known (Calcutta: Government of India Central Publication Branch, 1928). The difficulties of working dense tropical forests by means of convict labour, and peopled in parts by an indigenous race of hostile people, need scarcely be emphasised; whilst the marketing of the products, even of so fine a timber as the padauk (*Pterocarpus dalbergioides*) has been fraught with unforeseen troubles. Mr. Rodger's report, however, goes to show that a turning point has been reached; and given the hearty and maintained support of the Government of India, which nowadays includes the Legislative Assembly and the Standing Finance Committee, these forests should become the source of an important export trade.

For many years, when the Andaman forests were alluded to, the average person thought only in terms of padauk, the sole timber then exploited. Other species, for trade purposes, were negligible. No less than fourteen different timbers are mentioned in the report, of which *Sterculia campanulata* is exported to Calcutta and Rangoon for match-making; gurjan (*Dipterocarpus turbinatus, Griffithii, incanus* and *costatus*) to England, Madras, and Calcutta; the white chuglam (*Terminalia bialata*), which is in much demand as the source of silver greywood; whilst the use of padauk is almost world wide. A systematic survey of the forest crops for stock-mapping purposes is now in progress, whilst a logging engineer has reported on the possibilities of introducing mechanical extraction to supplement the elephants and buffaloes at present employed. The engineer estimated that there are some 1,870 square miles of forests which carry enough tonnage of timber per acre to make mechanical extraction possible. Even at the low figure of 20 tons per acre, this would give more than 20 million tons, and with a hundred

year rotation an annual extraction of about 240,000 tons would be possible, or about nine times the present output.

The Inspector-General of Forests states that a rotation of a hundred years would be too short to produce the requisite sizes of the valuable species such as padauk, gurjan, and white chuglam ; but he adds, it must be remembered that the forests are full of over-mature timber which is certainly deteriorating, and should consequently be extracted as soon as possible. There would seem to be, therefore, every inducement for the Government to sanction the sums necessary for the introduction of the new methods of extraction recommended ; the more so since the persistent efforts of the Forest Department have succeeded in placing on the market other species besides padauk, and that an increasing demand appears fairly certain.

On this head Mr. Rodger writes : "I have little doubt that the markets for Andamans hardwoods in India and England, and possibly also in South Africa, Mesopotamia, and elsewhere, can be gradually developed until we have an assured and profitable trade.............I look forward to the time when the very extensive mangrove forests of the Islands will be of value. Containing as they do as much as 160 tons of timber per acre, being most accessible and easily worked, it seems reasonable to imagine a time, not very distant, when the fuel market of Calcutta, now hard put to it to find enough fuel in the Sundarbans, will obtain its supplies from the Andamans. I understand that modern plant has been erected in the Philippines for the manufacture of tannin, wood alcohol, and charcoal from mangroves, and I see no reason why this should not be done in the Andamans ".

The explorations now being carried out in these forests should produce fascinating results both botanical and zoological ; some of the silvicultural work already undertaken, in plantations and so forth, offers possibilities of considerable success. Mr. Rodger is to be congratulated on his most interesting report : for restrained, as is the case with official reports, though its phraseology may be, it proves that opportunities for carrying out work and investigations of considerable value and interest lie to the hand of the Andamans Forest Officer. (*Nature.*)

REPORT ON A TOUR OF INSPECTION OF SOME OF THE TEAK PLANTATIONS IN THE STATE OF TRAVANCORE.

BY R. S. BROWNE, I.F.S.

As the period of my deputation was limited to one week, my visit had to be hurried through, but I was able to see, in that time, most of the areas under *taungya* regeneration in the Central and Shencottah divisions, as well as a number of plantations aged 1 to 4 years, and several of the middle-aged and older plantations. Before proceeding with my report I might remark that the Travancore Forest Department now has about 9,000 acres of teak

plantations, the oldest being sixty years, and that they are extending their plantations on a scale unheard of in Madras, with spectacular success, and at practically no cost to the State.

2. *Method of regeneration now employed.*—As the main object of my deputation was to study the Travancore method of teak regeneration, I shall describe it first.

The earlier plantations.—The oldest plantations were made by transplanting nursery seedlings. Some thirty to forty years ago this method was discontinued, and stump-planting was introduced. I could not ascertain the reason for the change of system. Stump-planting has been continued ever since.

Regeneration with field crops.—Six years ago *taungya* (the name used by the Travancore Forest Department) was started, and 'regular' plantations were stopped. The innovation was commenced on a small scale (at least small by comparison with later developments), 40 to 80 acres being taken up at a time. The first areas were entrusted to forest subordinates, who planted teak and grain at their own expense, and harvested the crops for their own benefit. They kept accounts of all items of expenditure and revenue, so as to convince the future *taungya* cultivators of the prospects to be expected from this kind of work. The Plantation Ranger, Aryankavu, (Shencottah division), gave me a note of his costs and profits on plantations which he raised in 1924 and 1925. On an area of 28 acres, which was cleared and burnt by the coupe contractor, the Ranger raised one crop of paddy, planted teak, weeded the paddy, paid watchers, etc., harvested the paddy and cleaned up the area after the harvest. Private individual undertook subsequent cultivation in the area. His net profit was Rs. 1,271-5-0 or Rs. 45-6-0 per acre. Clearing and burning on a normal area costs Rs. 15 per acre, and collection of seed, and nurseries cost Re. 1-10-0. If these charges were included the profit in the year of formation would have been Rs. 28-12-0 per acre. In an area of 80 acres, where, also, clearing and burning were done by contractors, he raised two crops of paddy and one of horsegram on 42 acres, and one crop of blackgram, one of gingelly, and one of paddy on 38 acres, and planted teak, etc. The blackgram was a total failure, and the yield from gingelly was Rs. 47 less than his expenditure in raising the crop. His net profit over the whole area was Rs. 1,160 or Rs. 14-8-0 per acre, and if the cost of clearing, burning and nurseries were included the whole enterprise would have resulted in a slight loss. Blackgram and gingelly were only tried as an experiment. It is now found that two crops of paddy and one of gram are sure to bring in a tidy profit, after deducting all the expenses on raising teak.

Success attended the earliest efforts, and the present year's clearings in the Central division (600 acres) are not enough to satisfy the demands of the cultivators. Developments have been slower in the Shencottah division plantations, as the population is small, and the soil and climatic conditions are possibly not quite so favourable as in the Central division.

Timber felling.—The timber in coupes to be clear-felled is sold standing to contractors, who pay from Rs. 30 to Rs. 120 per acre according to the quantity and quality of the trees, extraction facilities, etc.

Clearing, burning, etc.—The *taungya* cultivators fell the useless trees and undergrowth, and burn the areas. There have been no bamboos in any recent clearings, but it is said that a good fierce burn is obtained throughout the area.

Sowing paddly, etc.—In some cases the cultivators have been allowed to crop the clearings for the first year, and to defer teak planting till the south-west monsoon of the second year when the second paddy crop is on the ground. This concession has now been stopped, and teak is planted in the year of clearing. Paddy is sown broadcast during the April showers and the soil is hoed up with a mamuti, thus covering the seed.

Lining, staking and laying out paths.—The lining and staking are done by the cultivators under supervision. The espacement is 6′ × 6′, as they found that 12′ × 6′ encouraged serious side branching. The Forest Department also aligns inspection paths, 3 feet wide, along the contours (the country is hilly) at frequent intervals, and the cultivators cut the paths, and maintain them, until they hand over the plantations.

Seed collection and nurseries.—The Forest Department undertakes the collection of seed, maintenance of nurseries, and supply of plants to the cultivators. The seeds are collected from natural forests in localities where teak grows gregariously, and where the trees are of large size and good quality. The nurseries are made during the south-west monsoon. Roots of trees are extracted, the soil is dug to a depth of about 1 foot and powdered, and the beds are raised 1 foot to 15 inches above ground level. The beds are about 3 feet wide, and of any length, with about 1½ feet between the beds. The nurseries are usually located on a gentle slope, and the length of the beds is in the direction of the slope. The soil is free and porous, and the drainage perfect. The seed is sown, as a rule, late in July or early in August. The seeds are soaked in water for 24 hours and are then sown touching one another, *the object being to get seedlings with slender roots.* They are covered with a layer of soil of the same depth as the diameter of the seeds. No watering is done. Weeds are uprooted frequently by hand. No other soil working is done in the nurseries, but the soil remains free always, and never cakes. I saw some portions of nursery which were not used for the recent planting. The seedlings were very congested, with long, slender stems, and few leaves. If I had not seen the splendid results obtained with such plants, I should have considered them most unsuitable.

Stumping and planting.—Planting usually commences about the middle of June, and is completed before the end of July. The seedlings are then about 11 months old. They are pulled out of the beds like carrots (never dug out.) The stems are cut with a sharp knife leaving 1 to 2 inches above the collum. The root is pruned to a length of about 9 inches, and the small side roots (they are little more than root-hairs) are trimmed off. The stumps

are planted during rainy weather. Both stumping and planting are done under close departmental supervision. The holes are made with crowbars similar to those used at Nilambur this year. The crowbar is plunged into the ground, absolutely vertically, and to a depth exactly equal to the length of the root. The depth is measured by inserting the stump; if the collum is above the level of the ground, the hole is deepened : if it is below the surface, the hole is filled till the exact depth is obtained. (The coolies quickly become expert at getting the depth right, first time.) The stump is inserted in the hole, with the collum at ground level, and is held in position by the toes of the planter. The crowbar is then plunged into the ground to the same depth as before, some 5 or 6 inches away from the first hole, but this time in a slanting direction, the angle being about 20° to 30° from vertical. Using the crowbar, the first hole is closed, the soil being tightly packed all round the stump. It is considered essential to success that the soil should be absolutely firm all round the stump, with no air spaces and that the hole must be exactly as deep as the root is long. The test of proper planting is to try to pull the stump out of the ground by hand. It is practically impossible to do so, and to get this firm packing requires considerable practice. It took many attempts, on my part, before I could plant a stump to the District Forest Officer's satisfaction. He (Mr. P. Raman Pillai) was convinced that the rooting of stumps at Nilambur this year could be explained if they were not planted firmly. And it is true that they were *not* planted firmly, and I don't suppose a single one would have stood the Travancore test of pulling. At the same time, in the case of stumps planted in alluvium, in the time of heaviest rain at Nilambar, I doubt whether they could have been planted as firmly as is done in Travancore. Mr. Raman Pillai thought that this difficulty could be overcome by avoiding the periods of the heaviest rain for planting work.

Size of seedling for stumping.—It was a great surprise to me to find that they prefer seedlings with slender roots—something thicker than a pencil and never thicker than the forefinger. It has been their unvarying experience that these small stumps, alone, give a full percentage of success. Larger ones give very heavy casualties, nor are the shoots so good as in the case of small stumps. The theory of the Plantation Ranger at Aryankavu is that the shoots from a fat stump can and do live on the food contained in the stump for a long period, and there is no incentive to produce roots during the monsoon. They are caught napping when the rains end, and the food supply in the stump is exhausted. Thin stumps, on the other hand, have but a small stock of food for the new shoots; roots are produced early, and the plant is well established before the end of the monsoon. His theory seems reasonable.

Tending of teak under paddy.—No tending of the teak is undertaken while the paddy is on the ground. The paddy is weeded in its own interests, but it is allowed to grow all round and above the teak. The Forest Department endeavours to prevent cultivators using varieties of paddy which are very long in the stalk. I saw the *taungyas* just before the paddy harvest (harvesting had commenced in a few places) and often the paddy had fallen

down, completely covering the teak. The teak shoots everywhere looked healthy and were anything from 2′ to 9′ high, usually two or more shoots growing from each stump. By comparison with shoots growing in the open (*e. g.*, on the sides of inspection paths) those under the paddy were very slender—so much so that in some cases they lay down when the paddy was removed. But I was assured that they would very quickly recover, and grow rapidly, and my inspections of older areas prove that such is undoubtedly the case.

Harvesting paddy and uprooting straw.—The paddy ripens towards the end of September. First the ears are cut off and collected. Then the straw is uprooted by hand, under supervision, care being taken not to damage the suppressed teak shoots. Any weeds that exist are also uprooted at the same time. This operation loosens the soil to a depth of $1\frac{1}{2}''$ to $2''$ and is said to be very beneficial to the teak. The uprooted straw is laid in narrow strips, along contours, at frequent intervals—usually about 12 feet apart in the areas where I saw the operation done. It is claimed that the straw has considerable manurial value, and further the strips of straw along the contours prevent surface wash on the slopes.

Sowing gram.—Horsegram is sown in October, soon after the harvesting of the first paddy crop. The seed is covered by hoeing the soil with a mamuti, as in the case of paddy-sowing. The soil is disturbed to a depth of about 2 inches by this operation.

Replacing casualties.—There is such a favourable distribution of rainfall that the casualties from the first planting are replaced (by stumps) in the north-east monsoon of the first year. This work is very light, for on an average there are not more than 5 per cent. casualties, so successful is the original planting.

Subsequent work.—The gram is harvested about February and the remnants of the gram vegetation, together with weeds, are uprooted before sowing the second paddy crop. The latter is sown in April of the second year, in the same way as the first paddy crop was sown. It is weeded when it has grown up and is harvested in September. Paddy straw and weeds are then uprooted, and the plantation is handed back to the Forest Department free from weeds and fully stocked, in October of the second year, when it is about 15 months old.

Cutting excess shoots.—In the Central division the best shoot from each stump is retained and surplus shoots pruned off about April, i.e., before the second paddy crop is sown. In the Shencottah division this work is delayed for several years, because of a borer (not yet identified) which is somewhat common, and which, they think, is encouraged by the presence of pruned surfaces.

Departmental weedings.—After the *taungya* are handed back to the department, a knife weeding is done annually for five years, at a cost of Rs. 2

per acre per weeding. In the Central division there is dense, tall elephant grass in most places before clear-felling, and it seems to return even after three grain crops. It is not likely to be such a problem in future, for now that they have introduced an espacement of 6′ × 6′ instead of 12′ × 6′, and with the extremely rapid growth of the teak in these localities, the canopy should close in three years or less.

The rival merits of 'taungya' and 'regular plantations'.—The two District Forest Officers, and the Rangers with whom I discussed this question, are unanimous in their opinion that the teak grows better in the *taungya* plantations than in the regular plantations for the following reasons: (*a*) the soil is worked six times in the first two years—thrice by hoeing in order to cover the seeds of the grain crops, and thrice when the stalks, etc., of the grain crops are uprooted; (*b*) the gram crop adds much nitrogenous manure to the soil and the paddy stalks too have an appreciable value as manure. As to cost, of course, there is no comparison. The formation of the old regular plantations cost the department nearly Rs. 40 per acre. Now, in the Central division the cultivators pay Government Rs. 2-8-0 per acre for the privilege of growing grain for themselves and teak for the department, and the only expense to Government during the years of formation is the cost of seed and nurseries, which works out at about Re. 1-10-0 per acre when apportioned over the area of plantations served by the nurseries. Formation in this division is therefore achieved at a *profit* of about 14 annas per acre, exclusive of establishment charges. In the Shencottah division, where there is not the same demand for *taungya* cultivation, the right is given free of premium, so the cost to the department is Re. 1-10-0 per acre—the cost of nurseries and seed.

3. *Agency by which taungya plantations are made—Central division.*—In the Central division all the work is now done by co-operative societies. The new plantations of the current year amount to 600—acres 400 at Chenkara and 200 near Naduvathumuzhi—but the people are clamouring for larger clearings. The popularity of *taungya* cultivation is due to the fact that most of the labouring classes here (as elsewhere in Travancore) are educated, and prefer independence to manual employment for wages; and it is practically impossible for them to get the small holdings which would be within their means on a permanent tenure. The population in these two localities is large. Each co-operative society has something in the neighbourhood of 100 acres of *taungya*, and such a society often has as many as 100 members engaged in the cultivation of this allotment. The Travancore Government does not allow any individual member of a society to have a share of more than Rs. 25 in the working capital of his society's *taungya* enterprise. Most of the work is done by the members and their families, and very little hired labour is employed. Much of the paddy raised is distributed among the members for their own use, and I am informed that the people of these localities are quite independent of imported rice nowadays, whereas formerly there was practically no local rice. The restriction on the extent of individual shares in such a profitable undertaking is irksome to some of the

members, who have some capital and are ambitious to use it in cultivation on a larger scale. One of these members interviewed me and asked whether he might be given a chance to visit Nilambur and see the local conditions in case Government intends to go in for *taungya* thera. He thinks he could get families from his village to go to Nilambur with him, if the prospects are good. The people are, however, rather scared of malaria. He was undeterred by my suggestion that the accessible areas fit for teak at Nilambur were exhausted, as he thinks, he could easily raise other species with paddy, and says he is trying private experiments with bombax, *karumarudu Terminalia tomentosa* and rosewood.

Shencottah Division.—The population in the vicinity of the plantation areas (Aryankavu and Tenmalai) is small, but is increasing. Subsequent to the first efforts at *taungya* by the departmental subordinate, the cultivation and regeneration have been undertaken by the coupe contractors. It is likely that in future all or most of the clearings will be done by private individuals, and probably in course of time, when the population increases, the co-operative system will be evolved. The growth of the young teak in these localities did not seem to me to be in any way inferior to what I saw in the Central division, in fact parts are better. But I understand that the paddy crops have been rather poor because the contractor left himself very little debris to burn. (The plantation are along the railway, and charcoal manufacture is a lucrative business.)

4. *Climate, locality, etc., of plantation areas—(a) Altitude.*—70 to 500 feet in Central division, 1,000 to 1,500 feet in Shencottah division.

(*b*) *Climate.*—Warm and moist, like South Malabar, but quite healthy in the vicinity of plantations. The average annual rainfall is about 130 inches in the Central division areas, and slightly less in Shencottah division. The distribution of rainfall is extremely favourable. December, January and February are dry, but commencing with thunder-showers in March there are no dry periods of any length till the end of November. The south-west monsoon, is sufficient, but practically never excessive. The following is the average monthly rainfall for the six years 1919 to 1925 excluding 1924—extracted by me from the registers of the Koni estate (Malayalam Plantations, Ltd.):—

	Inches.		Inches.
January	2·01	July	24·74
February	2·10	August	16·49
March	5·41	September	13·48
April	7·71	October	14·46
May	9·80	November	8·82
June	25·40	December	1·61
		Average annual ...	132·30

(c) *Configuration of the ground.*—The earliest plantations were confined to narrow belts of alluvium along the big river which flows through Naduvathumuzhi and Koni. But such areas were of limited extent. The majority of the teak plantations in both divisions which I visited are in hilly country. The slopes are much steeper than at Mount Stuart, and run down to small streams which wind their way through the valleys. On the whole, the configuration is very reminiscent of the country round Parappa in South Kanara

(d) *Rock and soil.*—Outcrops of slab granite are common near the hill-tops. I could find very few outcrops of laterite, though they must exist in places. The soil is uniformly deep on lower slopes, though it is not, of necessity, shallow on the hill-tops, for some of the best growth is found in such places. Granite boulders, scattered on the surface, are very common. The upper soil appears to be a mixture of disintegrated granite and disintegrated laterite (the latter being small in proportion to the former) and form free, porous loam of reddish yellow colour. The proportion of laterite appears to increase at a depth of about one foot from the surface, and it was only in this lower stratum that I could find any laterite pebbles, and even here they were not common. The drainage is perfect.

(e) *Natural forest before clear-felling.*—I have no doubt that most of the original forests in the Central division plantation areas were evergreen. These localities were under hill-cultivation until some forty years ago, when they were reserved. The secondary forest is of poor quality, with an open canopy, above dense elephant grass in most places. The main species are—*Venteak*, *Dillenia pentagyna*, *Terminalia paniculata* and *tomentosa*, *Grewia*, *Buchanania latifolia*, some teak, a little *aini*, rosewood and bombax, etc. The natural forests around the plantation areas in the Shencottah division are still evergreen or semi-evergreen, and are secondary growth, for most of these areas were under coffee cultivation till fifty years ago when coffee was abandoned on account of disease. There are a large number of prosperous rubber and tea estates near the teak plantations, and the land is eagerly sought by planters.

5. *Quality of the teak plantations.*—My inspections were mainly confined to the areas under regeneration, but I saw also a number of plantations aged 1, 2, 3, 4 and 5 years, and several round about the ages of 20, 30, 40 and 60 years. The plantations have not been divided into qualities, and as such it is difficult to compare them with our Nilambur plantations. But I am bound to admit that, of the limited areas which I saw, my general impression was that they are, on the whole, better. I saw no failures and very little which could be compared with the poorest of the Nilambur III quality. In the oldest plantations, on alluvium, the heights of the best trees were perhaps not equal to the heights of the best Nilambur I quality of equal age, but the girths were greater, and the crowns much larger as a rule. Girths and crowns in plantations of 30 and 40 years also seem very good. The best parts of the young plantations are most impressive, many plants attaining 10 to

12 feet and even up to 15 feet in height in one year after planting, and the best are up to 25 feet two years after planting. Forking of leaders is not common, but there is much side-branching in these young plantations, for an espacement of 12′ × 6′ was adopted when *taungya* was introduced, and it was only discontinued last year, in favour of the 6′ × 6′ spacing. The stocking is almost invariably complete.

The first *thinning* takes place at the age of 7 years, followed by a thinning at 10 years, and thereafter a 5-year cycle is followed. The final thinning is at about 60 years. All undergrowth and creepers are cut before each thinning is marked. This is undoutedly necessary in localities where the undergrowth is very dense (*e.g.*, *eta* reed or thorny *acacia*) but I should not have thought it necessary everywhere. Defoliation is said to be common, but epicormic branches are not nearly so persistent as at Nilambur, because the canopy is closer.

6. *Underwoods and experiments* – *Artocarpus hirsuta*.—In plantations now aged 59 and 60 years, some 45 acres were undersown with *aini* 21 and 20 years ago. Broadcast sowing was adopted, and the stocking is uneven, but is fairly dense. In many places I saw stems as close together as 6 feet. The heights vary a lot, but the best poles are up to 60 feet in height, and are just below the crowns of the teak. All stems in a sample plot of 19 acres of the understorey were recently measured, and the average height was said to be 28 feet, and the average girth 20 inches. The crowns of the *aini* are small, and the shade cast is not heavy, though there is practically no undergrowth beneath them. The introduction of an underwood was stopped after two years' trial on the grounds of expense.

Swietenia Mahagoni. –var. *macrophylla*.—I saw a small experimental plot of broad-leaved mahogany planted two years ago under teak which was then 28 years old. The teak is good, with a fairly close canopy, and the mahogany is now 6 or 7 feet high, but many of the leaders are forked—probably due to a borer.

Tephrosia candida (' *boga* ').—This is a leguminous shrub which is grown in some estates as a cover crop under rubber. I saw an experimental plot in a good 3-year old teak plantation at Edapalayam (Shencottah division). The *boga* was sown in the second north-east monsoon after the teak was planted, *i.e.*, after the removal of the second and final paddy crop. The object of introducing this artificial undergrowth is to keep down undesirable weeds (especially grass), to protect the soil, and to enrich it by the addition of nitrogen. The teak canopy had almost closed in this area, but the *boga* was growing well under the shade; it was about 8 feet high, with a woody stem of about 2 inches diameter at the base, and a bushy top. The ground was covered with leaf litter, and the soil was free and porous, and in excellent condition. The *boga* is pruned at intervals (in the same way as tea bushes are pruned back) after the first year. Pruning makes the shrub more bushy, and stimulates its growth, and the prunings manure the soil. This was the first experiment with this species, but it is to be done on a considerable scale

in future, as the authorities are convinced of the value of this species as an undergrowth.

Vigna oleosperma.—*Vigna* is a leguminous creeper, which was first tried as a cover crop on rubber estates in Travancore, two or three years ago, and is becoming increasingly popular. It is almost the only cover crop now used on a large estate which I visited, and it seems admirably adapted to its purpose. It covers the ground rapidly, retains moisture and also retains all leaves which fall from the trees. It positively prevents surface wash on the steepest hills and, being a legume, it is a valuable manure. It is a surface creeper and does not climb; it is not more than 6 inches high. I saw an area in a 2-year old teak plantation at Naduvathumuzhi (Central division) where some cuttings of *vigna* were put in a few weeks ago. But as the weather was then rather dry the attempt was only partially successful. They propose to repeat the experiment, but I do not think it will be a success once the teak canopy begins to close. Under the light shade and open spacing of rubber trees the *vigna* flourishes, but I saw indications that heavier shade was unfavourable to it.

7. *Possible applicability of Travancore methods to Nilambur conditions—Regeneration by taungya.*—The officers, with whom I discussed the question, think that drainage is most important to the successful raising of teak with a paddy crop, and I agree with them. I do not think it advisable to continue the attempts to raise second rotation teak with grain crops at Nilambur.

As regards *taungya* in natural forest clearings, I think it is quite possible that miscellaneous species could be raised in this way, in clearings near Nilambur, at a small cost to Government, provided the right kind of cultivators settled on the spot and did the work themselves. As I have already stated, I found a man who wishes to try, if he is attracted by the prospects, after a visit to Nilambur. Protection of miscellaneous species from browsing could easily be undertaken by the children of the cultivators, and it seems reasonable to suppose that a reward of Rs. 10 per acre (or less) would be sufficient inducement to take the extra trouble involved in growing species other than teak to men who are accustomed to pay a premium of Rs. 2-8-0 per acre in their own country. It is also most likely that this man would buy the coupes standing, and Government would be saved all the trouble of extraction and sale, if this was considered desirable. If cultivators were to be attracted from Travancore, it would have to be with the approval of the State Forest Department, but I think this would readily be obtained, for even now they cannot cope with the demands of the *taungya* cultivators.

If *taungya* regeneration of miscellaneous species were not successful, the next step would be to induce the cultivators to grow teak in areas which are not now considered to be very promising teak localities. We have large tracts of forest which can produce good III quality and perhaps even medium, II quality teak, and if formation could be effected at no cost, or for a small reward, the financial prospects would be bright. The unhealthiness of the

localities would have to be considered, but the opening up of the country would improve matters in this respect.

The Mount Stuart forests would be particularly suited to *taungya* regeneration, but the unhealthiness of the country is the drawback. The question of damage by elephants would not arise in large clearings for the Travancore *taungya* country is full of elephants, but they do relatively little damage to the teak, and watchers prevent them ruining the grain. I have no knowledge of the Wynaad, but I fancy that fever would operate to discourage the immigration of cultivators. My description of the Travancore method of stump-planting might, however, interest the District Forest Officer, Wynaad, in case he ever has any difficulty in establishing stumps by the local method.

Tephrosia candida '(*boga*)'.--Apart from the conspicusus success of large-scale teak planting, the discovery of this leguminous shrub impressed me more than anything else that I saw in Travancore, for I consider that it may possibly provide the solution of the most difficult problems at Nilambur to-day.

(*a*) In the second rotation teak plantations, following a thorough ploughing in September of the year of formation, *boga* could be sown in the north-east monsoon. There seems every reason to hope that it would protect the soil, and keep it in a porous state suitable to the retention of moisture, while enriching it by means of the nitrogen-fixing property of the shrub. At the same time it ought to keep down grass and other undesirable weeds. Pruning the shrub at intervals would increase its density, and the prunings would manure the soil. If a profitable crop of gram (which is also a legume) could be raised in the north-east monsoon after planting, the introduction of *boga* could be postponed till the next south-west monsoon—this might be necessary in any case, if, as sometimes happens the north-east monsoon is unfavourable. It is thought that the life of *boga* is 6 to 8 years. This would carry it over the period of the first thinning of the teak. It would then be for consideration whether one or more additional cycles of *boga* would not be desirable, before introducing an underwood which would restrict epicormic branching. Marking and executing the early thinnings would be particularly easy if *boga* were the only undergrowth.

(*b*) In the old, open teak plantations where the soil is impoverished, and there is practically nothing to burn, the introduction of *boga* seems well worth consideration. It should keep down grass, enrich the soil and improve its physical properties, while providing material for a complete burn throughout the area after clear-felling. Being a low shrub, even though dense, the volume of combustible material would not be very great, but it would ensure the running of fire all over the area, and would help to ignite saplings of useless tree species, and teak branches, and reduce the work of heaping and re-burning. And the manurial value of its ash should be very considerable.

(*c*) In the second rotation failed areas, which formerly carried good teak crops and are now grassy wastes, it is possible that 8 years under *boga*

would improve the soil sufficiently to reintroduce teak. (I have been considering the introduction of bamboo to reclaim such areas, but this would be a slow, difficult, and costly process.)

In the last two classes of areas, *boga* would need assistance in establishing itself. The District Forest Officer, Shencottah division (Mr. K. S. Narayana Ayyangar), does not think that it could be broadcast among grass, with success, and suggested that the grass should first be burnt, or cut and burnt, and the *boga* seeds then sown broadcast, and covered by a light hoeing. Another method, which suggests itself to me, is to sow the seed in weeded circles, in rows. For broadcast sowing 4 lb. per acre are allowed. The seed costs 4 annas a lb. from rubber estates in Travancore and from the Travancore Forest Department. I shall see whether any seed is available on the estates near Nilambur. The District Forest Officer, Shencottah division, was good enough to give me a small quantity of the seed, which I propose to use experimentally.

Vigna oleosperma.—A possible use for this species in forest regeneration might be to grow it with a species like rosewood in the open. Rosewood in clearings at Nilambur suffers much from drought in the dry weather. *Vigna* would undoubtedly help to keep the soil moist, and would retain the night's dew for the benefit of the seedlings, enriching the soil at the same time. It would prevent wash from hill-slopes, and it is so low that it would not interfere with the growth of seedlings. Cattle are very partial to it, and probably deer would like it too. Whether this would be an advantage in providing a more tempting fodder than rosewood, or a drawback in attracting animals to the clearings, I cannot say. However, in fairly large clearings, without obvious rows of plants, I doubt whether injury by any animals would be serious.

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PROTECTION OF THE BISON IN SWEDEN.

Sweden now has the largest herd of aurochs, or European bisons, in the world. At one time they were threatened with extinction, but now they are on the increase. They were originally imported to Sweden and have been carefully tended in a special preserve at Engelsberg in the province of Vastmanland.

Similar work is being carried on with the beavers, which, owing to indiscriminate shooting, a few years ago were nearly extinct. After eight years of work there are about 20 prosperous beaver colonies, all of them on the increase. German hares and pheasants have been imported and are doing well.

Strict game laws protect animals of Swedish origin, particulary the elk and the bear. The elk is protected throughout the year, with the exception of two weeks in the early autumn, and is multiplying rapidly.

Boars are fairly numerous in the Government domains in the north, where they are completely protected. Among birds, the eagle and the swan are protected. —*The Times*.

AFFORESTATION IN WALES.

In a written reply to Mr Hopkin, Mr. W. R. Smith states that the Forestry Commissioners have acquired 6,744 acres (4,885 plantable) in Carmarthenshire in two groups called Glangwili Forest and Pembrey Forest, the former in and about the head of the valley of the Afon Gwili, and the latter south-east of the lower Towy Estuary. The average price paid per acre, including buildings, &c. was £3 6s 4d.—*The Times*.

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INDIAN FORESTER

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LEUCAENA GLAUCA.

This tree indigenous to tropical America is used in the Philippine Islands as a quick growing firewood crop and as a temporary crop on land overrun with coarse grass. It has run wild in many parts of India but in Northern India its growth is such that it could not possibly compete with coarse grass.

In making fresh plantations of *Leucæna glauca* in the Philippine Islands the soil is inoculated with soil from an old plantation and in consequence abundant bacterial root nodules are produced. An examination of the roots of local plants showed none of the large nodules found on the roots in the Philippine Islands. In order to see if the introduction of a special strain of bacteria adapted to *Leucæna* would lead to the invigoration of its growth in India, soil from an established plantation was obtained from the Forestry Bureau, Manila, in 1925. Tests were carried out in the Botanical Experiment Garden at Chandbagh. These tests appeared to show that the bacteria greatly improved the growth of the *Leucæna* but some of the control plants got accidentally infected and it was decided to repeat the trial in the new botanical experiment garden. Two seed beds were accordingly sown on 20th March, 1928, one being inoculated with soil from the old garden which in 1925 had been inoculated with soil from the Philippine Islands. The other bed was left as a control. The photographs reproduced in plates 33 and 34 show the non-inoculated and inoculated beds as they were on 24th September,

1929, after 18 months or two seasons growth. It is obvious that the control plant could not compete with coarse grass though the inoculated ones might do so. It is further noticeable that the control plants show a group at one end of the bed with more vigorous growth due probably to a recent accidental infection.

As regards the possible use of *Leucæna glauca* for reclaiming grass lands in Northern India it should be noted that this species is not altogether immune to frost and frost in grassy places might prevent it being of any use for the purpose. The plant is worth a trial in more tropical localities with heavy rainfall.

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THE INDIAN SPECIES OF NYSSA, LINN.

In the Flora of British India one species of Nyssa only is mentioned viz., *N. sessiliflora,* Hook. f. now known as *N. javanica* (Blume) Wangerin. Actually there are 3 species two of which are very much alike but differ greatly in the size of the fruit. One of these appears to require a name and I give a description of it limited to the points in which it differs from *N. bifida,* Craib which has been described in detail in Kew Bulletin 1913 p. 69.

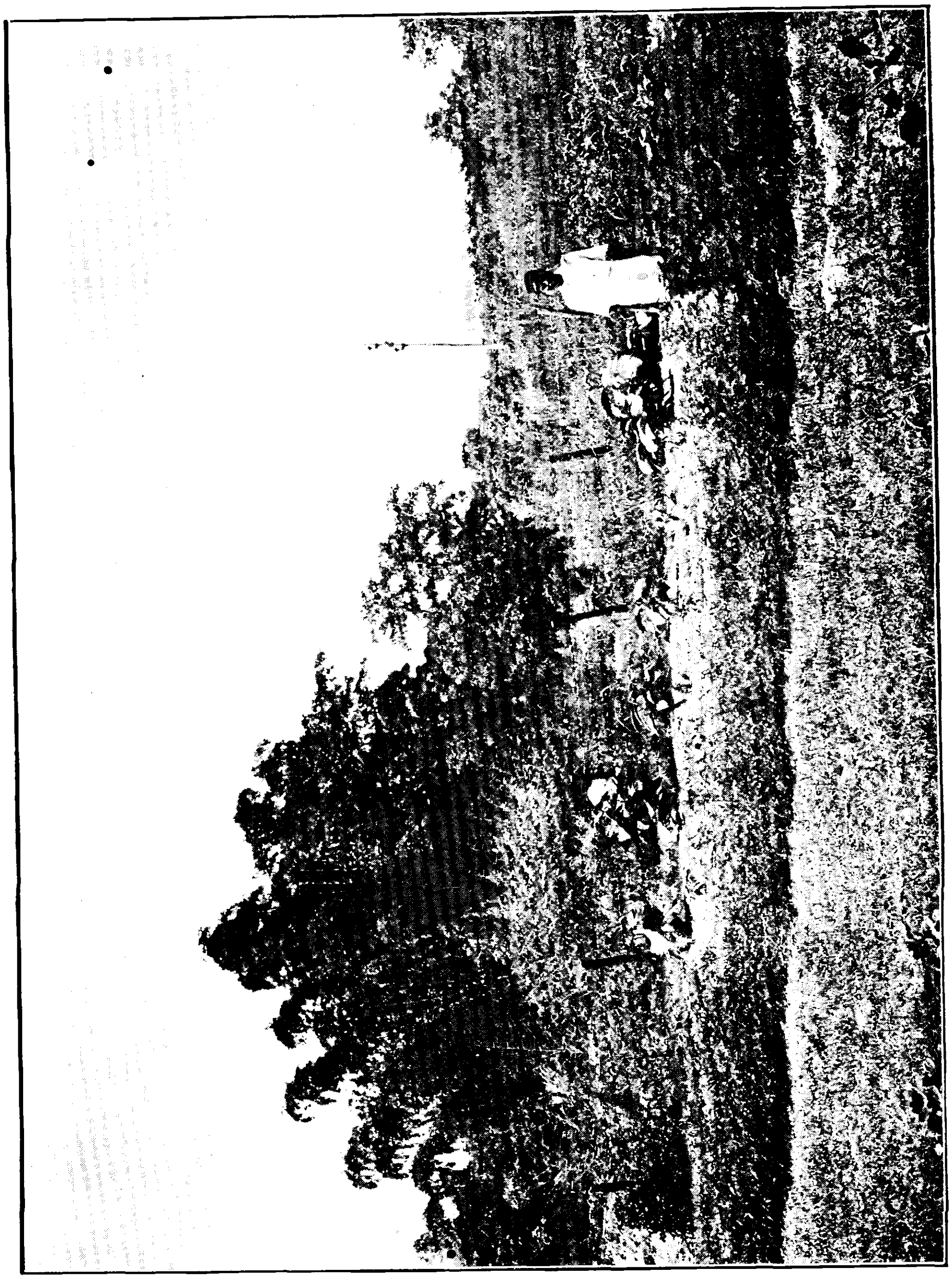
The species may be distinguished as follows :—

Leaves green beneath not papillose. Style undivided ... ... *1. N. javanica,*

Leaves more or less grey beneath, distinctly papillose under the microscope. Style bifid.

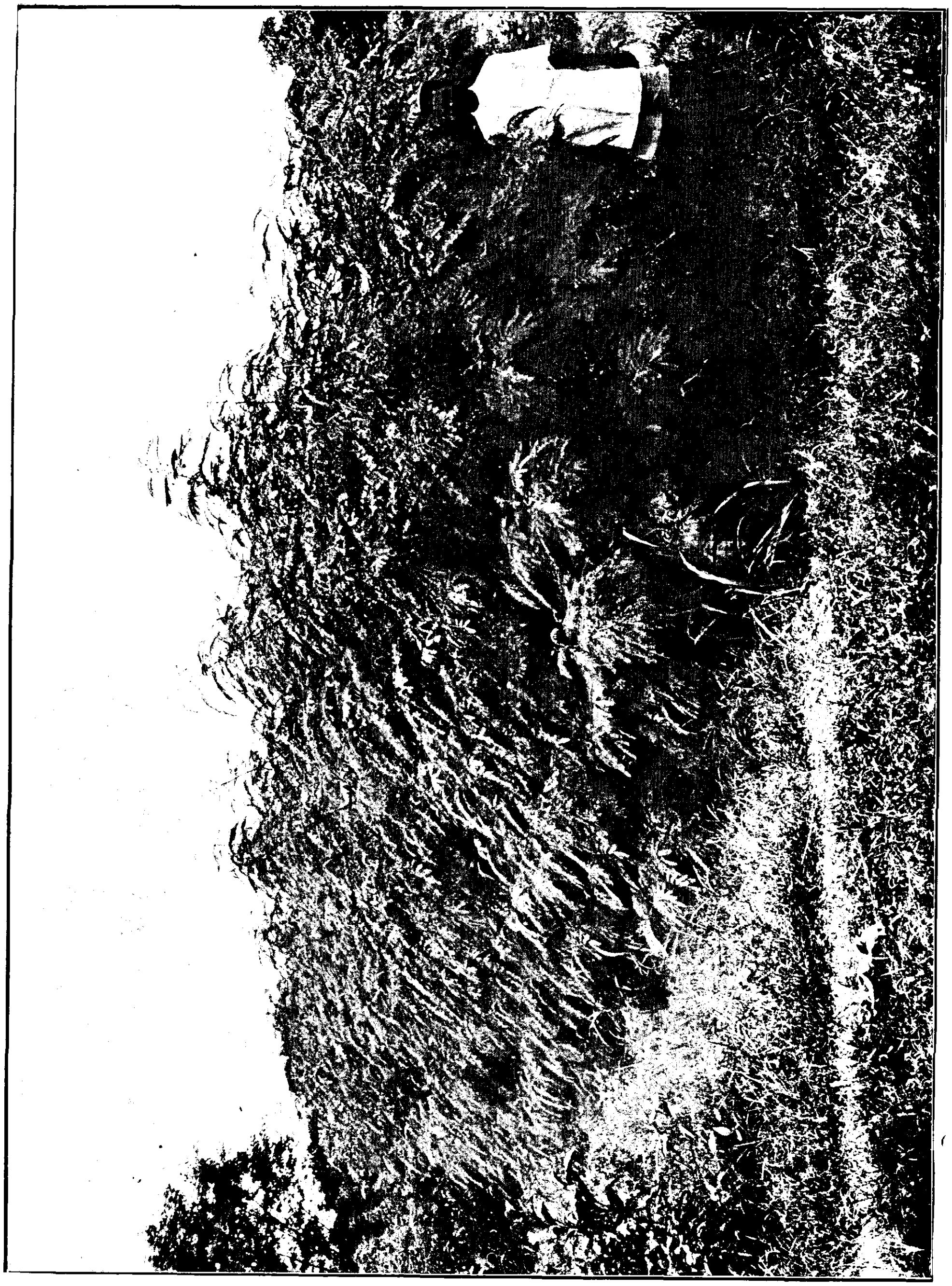
Leaves more or less hairy on the nerves beneath, lateral nerves 12—17 pairs. Males flowers on slender pedicels 4 mm. long. Drupe 12 mm. long ... ... *2. N. bifida.*

Leaves glabrous xcept sometimes in the nerve axils beneath, lateral nerves 8—10 pairs. Males flowers with a short obconical receptacle 2·5 mm. long. Drupe 4 cms. long ... ... *3. N. megacarpa.*



Photo—Har Swarup.

Leucaena glauca, soil not inoculated.



Photo—Har Swarup.

Leucaena glauca, inoculated soil.

There are often glands in the angle between the main veins and the midrib on the lower surface of the leaves. In the case of *N. javanica* the main veins on reaching the midrib turn downwards and run for a short distance parallel with the midrib before completely fusing with it. The junction is more or less glandular. In *N. bifida* and *N. megacarpa* the main lateral nerves leave the midrib abruptly at a wide angle. In *N. bifida* the glandular area is not very conspicuous but in *N. megacarpa* the glandular spot is usually provided with a tuft of short rather stout hairs.

Specimens of *N. bifida* from Assam look somewhat different to those from Siam and possibly are not specifically identical but I can find no satisfactory means of distinguishing them. They have been sent from Sibsagar at considerable intervals of time under the name *Gahorisopa* so that this name appears to be a good vernacular name for the tree at any rate locally.

N. megacarpa was called *panga-po* in Tavoy evidently owing to the likeness of the fruit to that of *Terminalia Chebula*.

In conclusion I wish to thank the Director, Royal Botanic Gardens, Calcutta, for the loan of material of this genus.

1. *Nyssa javanica* (Blume) Wangerin in Engl. Pflanzenr. IV 220 a, Nyssaceae (1910) p. 15. *N. sessiliflora*, Hook. f. & Th. *Ilex daphnephylloides* Kurz in Journ. As. Soc. Beng. 1870 ii p. 72! *Daphniphyllopsis capitata* Kurz l. c. 1875 ii p. 201, ex parte.

Sikkim and Darjeeling: T. Thomson, Kurz (*Ilex daphnephylloides* Kurz), King, Gamble 492, 813, 3107, 10536, Modder 93D, Forest Officials 14795, 39194-5.

Bhutan: Gamble 266.

Khasia and Jaintia Hills: Upendra Nath 5866.

Naga Hills: Reporter Economic Products 11488.

Perak: Wray 422, 1617.

Sumatra: Forbes 2880, Beccari 17, 335.

Java: Koorders 15203, 24170.

2. *Nyssa bifida*, Craib in Kew Bull. (1913) p. 69.

Assam: Hock 941. Lakhimpur, Mann. Sibsagar Clarke 37986, Peel, Forest Officials 44511. Cachar, Keenan, Owden, Upendra Nath 4867, Forest Officials 45938-9.

Burma: Amherst Parkinson 5282.

Siam: Kerr. 1713, 1716, 2594.

3. *Nyssa megacarpa* Parker sp. nova *N. bifidæ* Craib arcte similis sed foliis praeter axillas nervorum subtus nonnunquam pubescentes, glabris, nervis lateralibus utrinque 8-10, leviter arcuatis. Inflorescentia mascula receptaculo obconico ad 2·5 mm. longo. Capitula feminea pedunculo communi 2-3 cms. longo glabri suffulto. Stylus 3 mm. altus, ramis 2 stylo dimidio brevioribus. Fructus ellipsoideus 4 cms. longus, prominenter maculatus, putamen compressum 2·5 cms. longum 1·5 cms. latum.

Arbor 18 m. alta, 60 cms. diametro. Cortex lævis cinereus conspicue lenticellatus.

Tavoy *Parker* 2308; from the same tree 42300-4 June 1926.

Thaton *Lace* 4634.

Pegu (? Martaban) *Kurz* 1562.

Note on *Ilex daphnephylloides* and *Daphniphyllopsis capitata*. *Ilex daphnephylloides* Kurz in Journ. As. Soc. Beng. 1870, ii p. 72. Kurz gives the distribution "Sikkim Himalaya, in the oak forests of Tongloo &c." Kurz's specimen from Sikkim named originally *Ilex* and bearing the names *Ilex daphnephylloides* Kurz and *Daphniphyllopsis capitata* Kurz both in Kurz's handwriting is *Nyssa javanica* (Blume) Wangerin. The leaves are glaucous beneath as described by Kurz but they are not papillose. The specimen shows only the male flowers.

Kurz in Pegu Report App. B. (1875) p. 38 mentions *Ilex daphnephylloides* but quotes no specimens. He refers evidently to his own specimen 1562 from Pegu, Tookee ridges. This specimen is *Nyssa megacarpa* Parker. It bears the names *Ilex daphnephylloides* and *Daphnephyllopsis capitata* both in Kurz's writing.

Daphniphyllopsis capitata Kurz is first mentioned in Journ. As. Soc. Beng. 1875 p. 154. The locality given being Martaban 4-6000 ft. On page 201 a description of the genus and species is given. Kurz gives the localities Sikkim and Martaban. He quotes *Ilex daphnephylloides* as a synonym in both places.

Plate XV fig. 1, 2, 3, 4 is clearly taken from his specimen 1562 and 5, 6, 7 probably from Gambles No. 492 from Kurseong. In his generic description Kurz says "stylus simplex" which is correct for the Sikkim *Nyssa javanica* but not for his No. 1562.

In view of the fact that Kurz intended his *Daphniphyllopsis capitata* to be the same as his *Ilex daphnephylloides* it seems preferable to rename the plant represented by his No. 1562 rather than to transfer the specific name *capitata* to the genus *Nyssa*. *N. megacarpa* is in no respect equivalent to *Ilex daphnephylloides*. Nor does it seem to have been used in drawing up the generic and specific description of *Daphniphyllopsis capitata* though probably owing to the specimen being in better condition than those from Sikkim it was used for Kurz's plate of the species except fig. 5, 6 and 7.

DEHRA DUN:
12th April, 1929.

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RAMNAGAR FOREST DIVISION.

BY W. T. HALL, I.F.S.

SITUATION.

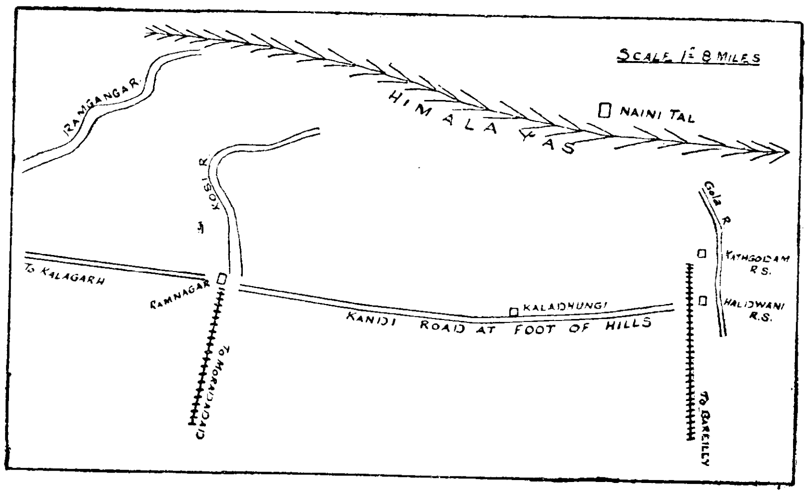
Ramnagar Forest Division is one of the important Divisions in the United Provinces with an area of about 300 square miles. It occupies the foot-hills of the Himalayas, roughly from the Gola river in the east to the watershed of the Kosi and Ramganga rivers in the west—a distance of approximately 40 miles.

The Kosi and Ramganga rivers are well known to anglers in Northern India. The Gola emerges from the hills near Kathgodam which is the rail head for the well known hill station of Naini Tal.

To many a divisional forest officer in the wilds or to a family man, one of the advantages of this charge will be that Naini Tal is headquarters of the Division so that one can recess during the rains in comfort and in cheerful company.

. . .

Ramnagar itself is only a small bazaar town at the foot of the hills and as it is fairly central, it makes a useful winter head-quarters for the Division. It is also a rail head and is the chief line of approach to the Division by rail *viâ* Bareilly or Moradabad ; and of course this is the chief line of export for timber.



TOPOGRAPHY, CLIMATE, GEOLOGY.

To one coming to the Himalayan foot-hills for the first time one of the most striking features of the country is the way that all but the largest rivers completely dry up except for a few months in the rains, and travelling from one end of the Division to the other in the hot weather one crosses numerous river beds containing nothing but large dry boulders. The streams as they emerge from the hills, disappear into the ground in a narrow dry tract known as the *Bhabar* emerging again in the moist malarious tract known as the *Tarai*. The effect of heavy rains in the hills on these streams is amazing. I have seen quite a narrow, bone dry river bed become a raging torrent, bringing down boulders and trees, so that an elephant could not cross. Within 48 hours it was again practically dry.

This dry *Bhabar* tract consists of a conglomerate of river bed deposit of enormous thickness. The foot-hills are of Siwalik formation consisting of the same conglomerate as the *Bhabar*

with sandrock and Nahan sand stone. The northern boundary of the Division practically follows the great fault of the Himalayas proper and the Siwaliks, and goes up to 5000 feet.

A very large part of the divisional forest officer's work therefore takes him over hills, which, though often undulating and gentle, are also rugged and difficult. They are always attractive. Nevertheless it is a relief to get away from them on occasions and a complete change of work and scenery is provided by Jaspur Range which is about 70 square miles of flat sal forest of the *Tarai* plains type, jutting out from the hills in the west of the Division.

Such different conditions of country give a very variable rainfall—from 90 inches at Kathgodam to 55 inches at Ramnagar. The hot weather is rarely severe except for a short period before the rains.

ROADS AND BUILDINGS.

It will interest sportsmen and others to know that a motor road has been constructed recently through the Division and if they are prepared to face an indifferent cart road for 5 miles from Haldwani they can reach the Division by car *viâ* Bareilly and Haldwani or from Naini Tal *viâ* Ranikhet. The road from Ramnagar to Ranikhet (55 miles) is one of the most charming motorable roads in Northern India, through sal and pine forest with lovely views of the Kosi valley and the snows.

An excellent cart road (the Kandi Road) runs through the Division along the foot of the hills from Haldwani *viâ* Kalagarh to Kotdwara. Local cart roads run through the forests from the more accessible foot-hills to the Kandi Road.

Very few Divisions have provided better accommodation for the subordinate staff and there are 18 excellent *pucca* bungalows at distances never greater than 10 miles apart.

The Division runs its own stationary hospital at Ramnagar under a sub-assistant surgeon with two travelling dispensaries in charge of compounders.

FOREST PRODUCE.

A high percentage of the forest stock consists of sal, which at present provides 93·8 % of the timber revenue of the Division

In the past several lakhs of revenue have been made from *khair* (*Acacia Catechu*) and there is a potentially important stock of first class trees of *sain* (*Terminalia tomentosa*), *haldu* (*Adina cordifolia*), *semal* (*Bombax malabaricum*) and *bakli* (*Anogeissus latifolia*) for which there is a poor demand from these parts. Chir (*Pinus longifolia*), *sandan* (*Ougienia dalbergioides*), *tun* (*Cedrela Toona*), shisham (*Dalbergia Sissoo*), *siris* (*Albizzia procera*) and *dhauri* (*Lagerstroemia parviflora*) are the commonest of the other important forest trees. *Bhabar* grass (*Ischaemum angustifolium*) and bamboos (*Dendrocalamus strictus*) form a regular and important contribution to the divisional revenue.

These hills contain some of the finest sal forest in the Province, of comparatively slow growth and producing a very durable hill sal timber.

During the last five years the average revenue of the Division was about Rs. five lakhs and in the previous quinquennium the average was as high as eight lakhs.

The bulk of the sal timber is taken out in the form of railway sleepers of which contractors supplied 43,456 last year through the divisional forest officer and very many more through middle men, including the largest sizes of special size sleepers for crossings and bridges. Besides the local hill contractors, many of our contractors come from the Punjab who bring their own sawyers as the *Pahari* makes an indifferent sawyer.

SYSTEM OF MANAGEMENT.

The entire Division is under the systematic treatment of a Working Plan.

About 40,000 acres, or less than ⅓ of the sal area, is under a system of conversion to uniform. On account of the comparative abundance of regeneration, saplings and coppice, we are not yet faced with the consequences of the failure to solve the problem of sal regeneration in this Working Circle, which is in an interesting and fairly advanced state of conversion.

The entire Jaspur Range with its fairly pure sal crop of 46,000 acres is almost entirely devoid of sal regeneration and presents a peculiarly difficult problem of its own.

Half of the sal area of the Division is allotted to a Hill Working Circle under improvement fellings but wherever more or less uniform groups exist markings have to be carried out in them as if they had been allotted to a periodic block in a uniform system.

A considerable sum is expended annually on intensive cultural operations the year after all fellings. Cultural jamadars with gangs are employed solely on this work throughout the season.

Trees are marked for felling by a selected staff under the prescriptions of the Working Plan. Sale lists are printed and the produce sold by auction on lump sum contracts. Careful estimates of the outturn are prepared and guarantees of the outturn of timber are given where possible. Sal lots fetch an average of about Re. 1-2-0 per c. ft. sawn and there is always tremendous competition to purchase.

HABITS OF THE PEOPLE.

But for the habits of the hill people (*Paharis*), labour would be a very difficult problem. Except in one area there are very few villages with a settled population throughout the year to provide sufficient labour for the forest contractors and for departmental work. Unlike Hannibal the *Pahari* cannot withstand the extremes of heat and cold. He positively dislikes both. They come down from the hills in thousands about November and settle in temporary grass villages at the foot of the hills. The next 5 months is a period of feverish bustle for everyone with any work to do; for as soon as the hot weather begins the *Pahari* begins to gaze longingly at his home in the hills and along the dusty roads there begins a trek of women, children goats and cows—"là—bas au lointain, nous voyons le troupeau s'avancer dans une gloire de poussière."

By the middle of May the jungle has resumed its air of sombre dignity and the tiger begin to take up their usual hot weather haunts amongst the pools in the *sots*.

SHIKAR.

Before 1918 the Division included the Ramganga river and the famous Patli Dun—a well known river for mahseer and an equally well known valley for tiger.

In those days, so several old *koi hais* have told me, it was easily the finest Division in India. In spite of the transfer of the Patli Dun to Kalagarh Division, it is still one of the most delectable Divisions—at least in this Province.

The Kosi does not hold as many or as big fish as the Ramganga, but it is a delightful stream to fish and I know that several 20 lb. mahseer have been taken out of it in the last 3 years. The biggest fish are taken on dead bait but it is pleasanter to fish this small river with a small light fly spoon and a 10′ trout rod.

The river is at its best immediately after the rains and again from the beginning of April to June, when the water is usually crystal clear.

The *sots* and valleys on either side of the Kosi are full of tiger in the hot weather. This last summer I saw five in five consecutive days. A motorable road runs along the bank of the Kosi and the mahseer and tiger in this block provide as pleasant a period of 10 days' shikar as one could wish.

The Kosi near Mohan Bungalow is only 8 miles from one of the best parts of the Ramganga river and the Patli Dun so that one could make a circular tour from Kalagarh up the Ramganga and down the Kosi through lovely scenery and one of the finest fishing and tiger countries in Northern India.

The other shooting blocks, except the most eastern block on the Kathgodam side, all hold tiger and provide good shooting. Panther are not so common as in the plains of the *Tarai* but are quite plentiful. Chital are usually fairly abundant and good heads can be shot in all blocks. I have rarely seen a sambhar stag that was worth shooting.

Barking deer are very common, bear can be shot in all blocks and *gural* are occasionally seen in a few places. The birds are jungle fowl, pea-fowl, black partridge and *kalij* pheasant but bird shooting is not good and it is one of the disappointing features of shikar in the Division that there are no duck or snipe.

The above remarks apply to the jungle along the foot-hills' Jaspur Range supplies all the usual shikar of the plains. This block is not particularly good for any one thing but provides as

good a bit of mixed shooting as can be obtained in any one place in the United Provinces. Besides the birds mentioned above there are florican, grey partridge and quail and occasional teal and duck. Chital, sloth bear and panther are more plentiful and easier to get than in the hill blocks. Black buck are common in the grassy *chors* whilst *gond* (swamp deer) and hog deer are easily obtainable. Tiger are perhaps not so common in Jaspur as in the hill blocks but twice during the last season, three tiger were shot during a 10 day shoot, and except during the hot weather there is always tiger about. It is worth while remembering that by the beginning of May tiger usually desert the plains jungle near the foot-hills and go up to the pools and cooler *sots* of the neighbouring hills.

Professionally—for its excellent sal forest and interesting silvicultural work; aesthetically for its charming and varied scenery; for its comfortable touring and for the excellent sport it provides, Ramnagar Division would be hard to beat.

PORTABLE FOREST SAW MILLS IN THE MADRAS PRESIDENCY.

It is hoped that a short discussion of the portable type of forest saw mills installed in Madras may prove of interest to Forest Officers generally.

The utility and desirability of establishing small saw mills in the forest is still a moot question and must be governed by the varying conditions to be found in different localities. Where a good market exists for timber sold standing to contractors at satisfactory prices capable of absorbing the entire yield of the forest area there is little justification for such mills. On the other hand where local markets are limited, adequate supervision possible, and a wider outlet is desired for forest produce, such plants may well prove to be of decided economic benefit.

In any case a short history of the Madras mills may throw some light on the problems to be solved.

An urgent scheme for the erection of four small portable saw mills was placed before Government on 21st June, 1924. The

urgency arose on account of the activities of the Railway Board Sleeper Committee which had just completed a tour of South India, following which a meeting had been held at Ootacamund with representatives of Government, the Railways and the Forest Department present. At this meeting the Railway representatives intimated that they were prepared to go ahead at once inaugurating a sleeper supply from the Forest Department *provided* the department would guarantee adequate quantities and start making deliveries the next year, that is 1925. They also announced their decision to put down a sleeper treating plant in South India whenever the Forest Department would or could guarantee adequate supplies of raw material.

These were matters of the greatest importance in increasing the saleable outturn from Madras forests and the opportunity could not be allowed to pass. Therefore the Portable Saw Mill Project was first put forward almost entirely with production of sleepers in view. It was held by Forest Officers of many years' experience that sufficient hand labour would not be available to insure the supply of sleepers needed, so mills were asked for.

Government held over the question until the treating plant was assured, but acceded to the request for a mill at the Beypore Depôt, to saw up the large stocks of surplus logs lying there on 21st October, 1924.

Finally the South Indian Railway agreed to accept untreated *karimaradu* (*Terminalia tomentosa*) sleepers at Rs. 7-8-0 each and a revised estimate for the remaining three saw mills was sanctioned on 2nd December, 1925.

One was placed at Pollachi in order to saw up the large surplus of low grade logs that had been accumulating at the depôt there for some years. Another was located at Chedleth in the Wynaad to saw materials which would not bear the cost of transport to Mysore and Nanjangud depôts for sale as logs, and the third was placed at Parappa in the South Mangalore Division in order to utilize a larger outturn from adjacent forests.

As each of these mills is now working under somewhat different conditions from the others and is in a way a separate

experiment, I will discuss each in turn pointing out the particular local problem to be solved and the results obtained so far, with recommendations for future working.

While originally put down for sleeper sawing, none of the mills is now used primarily for that purpose due to constantly changing conditions. At the same time the question of portable saw mills is one of the most important in the Presidency. The Forest Department is not utilizing more than 10 per cent. to 15 per cent. of the growth of the forests and cannot increase this percentage to any great extent if it limits itself to the sale of logs of good enough quality to bear the cost of transport to competitive markets. At the same time poor quality logs manufactured into lumber not only find wide and diverse markets, but having left 50 per cent. or more of their volume in the forest as waste, can bear the cost of transport for much greater distances. As a rule sawn timber does not compete with logs from the same area in local markets, hence a larger volume of forest produce can find a profitable market from a given area. Again the wider distribution of the product assures better average prices, as they cannot be so easily controlled by rings of local buyers. Also by regulating the supply of logs to be auctioned, the economic price can be realized. Any surplus can at once be marketed as sawn timber for which a general widespread demand exists.

Therefore in assessing the value of portable saw mills two factors must be kept in mind :—

(*a*) By helping to increase the total outturn from any given area, overheads on logs as well as sawn products are proportionately decreased.

(*b*) By maintaining a secondary outlet for disposal of outturn the supply of logs for auction may always be regulated according to economic demand. No surplus accumulates which would reduce log prices due to over supply.

These are indirect benefits and do not show on the balance sheets of the individual saw mills. They should however show in the increase net revenue from any forest division operating such a mill over a period of several years.

. . .

Some of the mills have become efficient much sooner than others, due largely to local conditions. This does not necessarily mean that the others cannot be made efficient, only that more difficulties will have to be overcome. Therefore, in order to judge what the final results will be, a period of at least 5 years should be allowed. New and unforeseen difficulties are always likely to arise and the development of new methods and new procedure in any line must be, in India especially, a matter of slow evolution.

(1) *Beypore Saw Mill*:—This mill, originally the smallest unit installed, was placed in the Beypore Depôt in order to convert the large surplus of logs there into railway sleepers for which the Department had an advance contract.

On the completion of this work, it was found from the cost data accumulated, that a greater return could be realized by sawing planks and scantlings for the market. Therefore the mill was re-organized for this type of sawing and two surplus engines were moved from Chenat Nayar for added motive power.

Originally the mill was placed under the direction of the District Forest Officer, Nilambur, with technical advice from the Engineering Branch concerning the running of the machines. After six months' work, however, this method of control was found unworkable. The District Forest Officer had no knowledge of either mechanics or saw mill engineering and in any case could only visit the mill once or twice a month. The upkeep of the machinery and belts was neglected and whenever the crew wished for a day or so off, a convenient "breakdown" occurred. Technical advice given by the Chief Forest Engineer, the Logging Engineer, and Major Chipp was disregarded, no cost accounts were kept, and the sawing of timber to advantage from the outturn point of view was impossible as there was no one connected with the mill who possessed experience in this phase of the work.

The mill was taken over by the Engineering Branch from 1st September, 1927, and has since shown a marked improvement in operation. It saws from 90,000 to 1,00,000 cubic feet of logs

per annum and has proven most useful in helping to control the sale of logs and timber from Nilambur. Log prices have increased steadily as has also the average return from sawn timber.

This mill forms a very important link in the marketing of converted lumber as it is the only place where orders for long lengths in teak scantlings can be placed. In the other mills only very low grade teak is sawn and unless we can supply complete orders for sawn material we lose the orders. This is especially important with respect to railway orders which amount to Rs. 40,000 to Rs. 60,000 per annum. When such an indent is received it is apportioned out to various mills according to the stocks of logs available and to the work in hand. The long length sections almost invariably have to go to Beypore.

In operation the work has settled down and a competent foreman and crew have been trained. There have been some criticisms lately concerning increased costs of sawing. This has been due however entirely to arbitrary increased overheads. Heavy interest charges have been added in addition to a very much heavier charge for the general supervision of the Chief Forest Engineer until the overheads now amount to 20% of the total costs. They should not be over 10%.

Recently a railway key machine has been added to the equipment. This should increase the profits and decrease the amount of waste.

By 1930, when the Chief Forest Engineer's and Major Chipp's overheads are automatically removed, this mill should prove a very efficient unit in adding to the general net return of the Nilambur forests, and personally, I regard its development as successful in meeting the particular needs for which it was designed.

(2) *Pollachi—Top Slip Saw Mill:*—Sawing the accumulated stock of old logs at the Pollachi Depôt started in June 1926. By February 1928, 1,19,503 c.ft. of logs had been converted. This was the surplus of logs which could not be disposed of by auction without glutting the log market and depressing the prices received.

Due to the fact that the logs sawn were of very poor quality and had deteriorated very considerably during the years they had laid in the depôt the outturn was only a little over 36%, as no deductions for defect had been made in measuring the logs. This low outturn taken together with the high value placed on the logs and with the general inefficiency of the saw mill crew resulted in a very much poorer financial showing than had been expected.

In February and March 1928 the mill was moved to Top Slip in the vicinity of the timber coupes now being felled, with the object of converting such logs as cannot be transported to Pollachi and sold at a profit. This will save the transport charges on waste, enable a greater outturn to be utilized from the forest, and make possible the conversion of the logs in a fresher condition.

The working of the mill is slowly improving although for several months after the move sufficient labour could not be secured to work the machines due to the inroads of fever. This will of course affect the financial showing during the present year.

Here again financial results are at present more a matter of the method of book-keeping than of actual management.

As many good grade logs as can be economically sold in Pollachi will be sent there in any case. The market for the lower grade logs left in the coupe or along the road-side is extremely limited and the prices low. To sell large quantities of such logs *in situ* would certainly affect the Pollachi log market adversely. Therefore to saw them up in the forest and distribute the lumber to the East Coast markets of the Presidency is of decided economic advantage.

This can be done at a profit if the logs are charged to the mill at their actual cost. The added actual expenditure to the Division in delivering the logs to the saw mill is about 4 annas per c.ft. If they are allowed to rot or are burned, the cost of felling and dragging them, which is incurred in any case, is lost, and the general overheads of the Division are not lowered by their inclusion in the return of saleable outturn. Therefore any

return to the Division above the 4 annas transport charges is really a direct profit.

Under the present rules, they must be charged to the saw mill at Re. 1-2-4 per c.ft., which is the audit cost of last year's logs at the same place, including 12 annas per c.ft. of overheads. This figure is of course far in excess of their actual value and taken with the fact that reasonable deductions are not made for defects in measuring the logs, makes a book profit impossible. Therefore to judge the present or future value of this mill to the department on a basis of current audits is impossible.

In the meanwhile, we have transferred a surplus engine from Olavakkot to increase the power in this mill in order that faster and more economical sawing can be done.

The intake of logs and percentage of outturn have been increasing lately and it is hoped that by early next year the mill will be on a much more efficient basis than has been the case in the past. It is in one of the most advantageous positions of any of the portable saw mills to prove of real service and it would be a great pity to prejudge its value before more accurate accounting and more efficient operation can be brought about.

(3) *Chedleth Saw Mill:*—This mill, together with the Pollachi and Parappa mills, was sanctioned on 3rd December, 1925. Erection was started in July, 1926 and sawing commenced in October, 1926.

On the whole, although mechanically good and the cheapest steam powered mill we have, Chedleth has given more trouble and less satisfactory results than all the others combined. This has been due first, to the extreme unhealthiness and remoteness of the locality and secondly to the fact that for many months we were unable to secure any sort of competent supervision or labour. From the start the inherent difficulties of having to operate under rules and regulations formulated to meet an entirely different sort of situation have been most marked. In all about Rs. 2,500 in extra charges, not found necessary in the case of other mills have been spent. Labour has been extremely difficult, at least 6 men of those recruited dying of fever, and we have twice had to

discharge the entire crew. Accounts have been in a chaotic condition due to incompetent saw mill Foresters. It takes 67 days to recruit and train a man for this position and the average time at the mill put in by such men before their incompetency could be proven beyond doubt was 60 days. There was a great deal of trouble with carting and only now is the sawn material being moved to market in appreciable quantities.

However even with the discouragements of the past two years in view, I still believe that the operation could be made a success. We now have a competent Ranger in charge, a better crew has been secured based on several experienced men who had been working as a second shift at Olavakkot, arrangements for carting and marketing have been concluded along satisfactory lines, and a new all-weather road from the mill to Sultan's Battery is under construction. Health and sanitation have been improved and actual operation of the mill should be brought to a state of comparative efficiency by the end of this year.

All that is needed now is for Government to take a purely business view of the accounting system to enable the management to begin to show profitable results. The same view should be taken of this mill as pertains to Top Slip. All first and second grade logs which will stand the heavy transport cost to Nanjangud should be disposed of there in log form to the extent that the market will absorb at economic prices. Lower grade logs should be sent to the mill.

An allowance for defects should be made in measuring logs for the mill and they should be charged for on the basis of extra cost to the district in delivering them to the mill. This, in the case of clear felled areas, would amount to cost of dragging plus the carting charges. In selection areas the cost of felling and cross cutting would be added. The argument will probably be advanced that these low grade logs are saleable in the coupe. No doubt some of them are, in limited quantities, but the entire amount consumable by the mill is not saleable. With reasonable measurements the mill should be able to show at least 50% outturn and should convert about 80,000 c.ft. annually giving 40,000 c.ft. of sawn timber. The cost of logs to the

mill on the above basis would not be over 4 annas per c.ft. or 8 annas in sawn outturn. Cost of conversion should not be over 12 annas per c.ft. which would make the sawn timber worth Re. 1-4-0 at the mill. Carting costs 12 annas per c.ft. and depôt charges and selling commission would add another 4 annas. Hence the total cost of sawn timber at Nanjangud would be Rs. 2-4-0 per c.ft. The average sale price of sawn timber at Nanjangud during 1927-28, which included about 1600 c.ft. of rejected sleepers sold at a low price, was a little over Rs. 2-9-0 per c.ft. The price during 1928-29 should be better, but taking the above, we could except then a profit on mill sawing of Rs. 12,500 which is 45% on the investment of Rs. 27,758. That this is not an unduly high estimate is borne out by the fact that the cost of conversion at Parappa, which is a mill of the same type as Chedleth, has been kept under 11 annas per c.ft. Such a result would certainly be better than to scrap the mill before every chance had been given of making it a profitable investment.

At present only three species of logs can be sold profitably at Nanjangud, teak, rosewood, and *vengai* (*Pterocarpus Marsupium*). There exists at the same time a good demand for *karimaradu* (*Terminalia tomentosa*) and *pillamarudu* (*Terminalia paniculata*) in sawn form. Small quantities of these latter species can be sold at the road-side at from 4 to 6 annas per c.ft. which, while it a little more than covers the cost of extraction does not cover the district overheads. Therefore taking a long view of the future good of these forests, which extend over 1,20,000 acres, it would seem desirable to develop, if possible, an ever widening market for the species which do not sell to advantage in the log.

(4) *Parappa Saw Mill*:—This mill presents still another angle. Its efficiency has been the highest of all the mills and due to a good foreman and a healthy location, there has been no trouble with labour or mill staff.

The South Mangalore forests produce a fairly large quantity of small logs from the mixed deciduous areas, hand sawn sleepers from some of the more remote forests, and some larger logs from

mixed evergreen and deciduous forests. Most of the first classification of logs were formerly sold at Kasargod but realized comparatively poor prices due to their small size, (they only average from 10 to 15 c.ft. each) and to the comparatively restricted local demand. Nothing like the quantities of logs converted in the saw mill could find an economic market. Therefore the mill makes possible a much larger outturn from the forests as its intake is nearly 90,000 c.ft. of logs per annum.

This was the last of the saw mills to be erected and started sawing in March 1927. Experience gained in the erection and operation of the other mills made it possible to design this plant to the best possible advantage and it is I think, one of the best, if not the best, portable saw mills in India. Although the logs average only about 12 c.ft. each, the production cost of sawn timber is the lowest of any of our mills and from the present cost data and last year's average sale price at Kasargod, it would appear that the Department is securing a royalty of about 5 annas per c.ft. in the log for all species of timber consumed. The mill is therefore returning a very good dividend on the investment.

Sales of sawn timber at Kasargod are difficult, however, as the local demand is small and freights are about 4 annas per c.ft. higher to our normal markets. We therefore have to allow for the freight differential in our prices. Another difficulty is that, as the logs are small, the outturn shows a high percentage of short lengths making it difficult to balance our orders.

An extension to the bolter which will make for still better outturn has been sanctioned by Government and we expect to still further increase the efficiency of this mill. It is an example of what all the portable saw mills should eventually become and should fulfil original expectations.

(5) *General*:—In general I expect these portable mills to prove that a larger outturn can be marketed to advantage from existing forest areas by being able to reach wider markets and by saving excess transport charges.

The problem of management is one which cannot yet be definitely settled. From experience to-date I am inclined to

believe that when a permanent organization is given effect to they should be run under the direct management of the Forest Engineer, Madras, who will be in charge of all forest engineering work in the Presidency. The product will be turned over to the Forest Utilization Division for sale as at present. In no other way can efficiency of operation be attained and sales be co-ordinated.

CHEPAUK, MADRAS,
Dated 22nd August, 1929.

C. S. MARTIN,
Chief Forest Engineer, Madras.

THE PRACTICAL SIGNIFICANCE OF FOREST TYPES.

EXTRACT—*Medd. f. St. Skogsförsökanstalt 22, 1926.*

H. Hesselman, Summary, Chap. XIV, Sect. 3, p. 538-41.

(Studies on the humus cover of coniferous forest, its properties and their dependence on silviculture).

Summary (Translation).

In the foregoing dissertation [on the humus layer of coniferous woods] the composition of the soil vegetation has been used in a general way for distinguishing and recognising the several types occurring. I have followed in this matter the old tradition in Swedish forestry which, originating with Örtenblad in in the '80ies and developed by Nilsson and others, has become a guiding light for the work of the Forest Research Institute. In 1909 Cajander published his well known work on Forest Types in which he recommends them as a basis for assessment of quality. He holds that consideration of types would provide natural quality classes common to all species, and so would greatly facilitate comparison of the yield of different species on different soils. This would unquestionably be a great objective. Cajander's proposal cannot however be accepted on many grounds, either by the Swedish Forest Research Institute or the rest of the Forest Service. Even within the narrow limits of the several types of Cajander's first work, there is a big range of increment in one and the same type and in a very restricted locality (*e.g.*, Evois

State forest); and the several types overlap one another considerably in this respect. The same result was obtained in the stock-mapping of Varmland forests in 1914 where several types were distinguished and at the same time allotment to quality effected on the height increment. In principle, this fact underlies Cajander's first book: a great variation with regard to current increment in one and the same type and also differences in respect of yield. Consequently a quality assessment on types must yield uncertain results when used in a given wood or a given small region. There might be in the region a predominating number of + or—variants of the type in question. If we know the average productive capacity of the type in a given region, we can naturally give an average value for the region with such a basis of allotment, but for the individual crop we shall get more uncertain results than when basing on the increment of the trees. If Cajanders's method is to have a practical value, the region must not be very big. Consider a type as general as Cajander's *Myrtillus* or *Oxalis-Myrtillus* type. The greater part of the Swedish spruce forests belong to it. The yield of this type varies very greatly in a country like Sweden where climate varies with the height above sea level, the latitude, and distance from sea and lakes. Average productivity values of this type for the whole country can only have a general statistical value.

I also rather think than even in Finland where the forest types have been adopted as a basis for quality classification, the difficulties which are inherent in the method, are not disposed of. Ilvessalo (1922) has demonstrated that even with the way the Finns delimit their types, the yield varies considerably and the types merge into one another without definite limits. Cajander (1923) himself has to admit that basing the nomenclature of the types on the vegetation can easily be deceptive, as woods which according to the soil cover are of the *Myrtillus* type, can be very different from the true *Myrtillus* type, and *Oxalis acetosella*, the typical species of the *Oxalis-Myrtillus* type, may be absent from it. Further, if one recommends as Cajander and Ilvessalo (1921) do, that the quality type named after the vegetation should be

determined from the increment of the trees, and then considers that in the future measurements will probably become necessary for the sub-division of the types based on vegetation, one is involved in a vicious circle of argument. If a close relationship exists between crop increment and soil vegetation, the procedure is unnecessary, and if there is no such relationship it is worthless. Considering the present state of our knowledge, it appears to me that the only correct procedure is to indicate quality classes by ordinals implying a certain production and to distinguish the several quality classes on the spot with reference to the increment of the trees, making use of any indications the vegetation may provide. The use of the vegetation for describing quality classes carries the implication of a more intimate relationship between the living soil cover and tree increment than is justified by the present position of research, and this attitude is in my opinion a dangerous one for the purposes of forest biological investigation.

Yet another ground on which Cajander's types are unsuitable as quality types is that the quality or forest type is considered as independent of the tree species. This brings up the question of the effect of the crop on the undergrowth. Cajander represents the view that this effect is small or of minor significance. If forest type is determined simply on soil vegetation, one can again get involved in an argument in a circle. The differences which occur in the vegetation in crops of different tree species, should not rest on the influence of the trees but should be explained as due to the fact that one is dealing with different forest types. In order to settle the point, it is necessary to investigate the soil vegetation in crops of different tree species but on soils which in respect of aspect, geology, moisture, etc., are as similar as possible. If our three northern species, pine, spruce and birch, excercise no very striking influence on the soil vegetation, poor in species (at least in North Sweden), Ilvessalo's own investigations (1922) show that the spruce on account of its deep shade excludes several species. It is quite a different question with broad-leaved trees such as oak, beech, lime, elm, etc. Even when one admits that certain plants always occur in association with certain trees, the relations are very complex. Linkola (1924) studying forest types in

Switzerland, with a bias in favour of Cajander's views, has proved nothing more as far as I can see than that the influence of the crop on the soil vegetation is different on different soils, which is not exactly surprising. Rubner's (1925) investigations in the virgin forests of Bilovic strongly support the view that the crop as such influences the soil vegetation, and the Finnish investigator W. Brenner (1922), a botanist and soil expert, has demonstrated for the forests of Finland, the effect of tree species on soil vegetation.

Even if the soil vegetation is not influenced by the different tree species, the productivity of the soil may be affected by it; this, too, is admitted by the supporters of the Finnish School, as is apparent from the interesting investigation into the correlation of crop increment and soil properties of Ilvessalo, a pupil of Cajander's (1923). Of this, he says that the crop affects the soil the more favourably, the more vigorous its growth, as it draws on the deeper soil layers with water charged with mineral salts, and adds humus, on the decomposition of which nitrogen-fixing organisms add to the nitrogen content of the soil. This is clear evidence of the connection between crop and soil properties which agrees with my view. As the roots of different tree species draw on different depths of the soil with different fauna, their effects on the soil must be different. One support of the sub-division into forest types independent of tree species is thus removed, except for those areas where there has been no change of species and where the development has not been restricted by undecomposed humus cover. In Sweden such areas are very limited: fellings and fires have affected the distribution of tree species, and the rotting of the humus layer may be slow under quite natural conditions.

The crop, and the tending of it, react on the soil in many ways, through the effect on the evaporation, temperature and fauna. Crop and soil stand in a certain relationship to each other; the influence of the crop will vary according to the geology, water relations, climate and so on, being sometimes greater and sometime less. For rational silviculture, it is of great importance to analyse this interaction clearly.

Cajander's theory of Forest types which has received considerable attention in foreign literature has so far gained no supporter when it is a question of applying forest types as units for quality. Rubner (1925) has made an interesting study of this question and is unable to accept the theory for Germany particularly because a change of species has usually taken place on the same soil. He demonstrates that it is misleading for all coniferous forests which have followed broad-leaved crops. Cajander (1923, p. 7) particularly mentions modifications of a type consequent on the action of a given tree species *e.g.*, spruce, but as these changes may extend over centuries of time one can make little use of a quality class allotment based on the type theory, quite apart from the difficulty and uncertainty of reconstructing in practice the original type. In this matter the subjective point of view may easily prevail over the objective. Leinigen, Hartmann and Krauss hold similar views. Wiedemann supports Cajander's theory but his investigation on the changes in the humus layer, which agrees perfectly with mine, point to a change of crop quality consequent on the action of different species. Here in Sweden, Tamm and Petrini have voted against allotment on the type-basis, and with them are ranged almost unanimously the foresters of Sweden. In Denmark, Cajander's theory has found an understanding interest with Bornebusch but he does not agree with the method, and constitutes in addition to the basic types, special *condition* types, determined by the influence on the humus layer of the tree species and tending. This is a point of view closely parallel to the one put forward tentatively by me in 1914 and supported in my lectures on soil science to the forest school. The difficulty lies not only in the fact that the different condition types have to be referred to definite basic types, but also in evaluating the influence which the "condition" may have had on the yield of the soil during the varying length of time it has lasted.

The study of types at the Swedish Forest Research Institute has had from the start an objective other than the creation of certain quality classes. The types should serve to sub-divide our various crops into types of equal biological value, which (as a

result of their different geographical position, of the different condition of their humus cover, of their different developmental history) may have a varying productivity but still in a general way will react similarly to forestry measures. From the Swedish point of view, one might term the forest types 'treatment types' instead of Quality types. In so far as Cajander's theory emphasises that certain types require similar treatment on broad lines, we agree with it. At the Swedish Forest Research Institute, in distinguishing types the vegetation is considered in the first place, and the growth of the trees does not influence the identification of the types. In a forest of the *Myrtillus* type, *Myrtillus* and the other particularly characteristic plants must be present, and in a forest of the *Oxalis-Myrtillus* type, *Oxalis* and the other species indicative of the type should not be absent. The types as we distinguish them correspond to the associations of the ecologists, admitting of course that the limits of our associations may be different from theirs. At the Research Institute the study of types aims in the first place at causal connections and endeavours to find out the factors which affect the increment of the crop and the effect of forest measures on these factors. It is freely admitted that we can only determine certain factors—by no means all of them—from our investigations. Much has been gained already from an understanding of a few factors. The new form which Liebig's old law of the minimum has gradually taken on, and according to which the different factors work in such a way that (as among others, Romell has proved) the several increment factors can replace one another in the dynamic system which they conjointly build, provides strong support for such a conception. Even if one cannot influence the minimal factor when one gains control of a certain increment factor, one can still influence the increment, as the minimal factor is the better utilised the more favourable are the other growth factors. The attempt will next be made to analyse from this point of view what possibilities silviculture offers of influencing the productivity of the soil.

H. G. CHAMPION, I.F.S.,
Silviculturist.

THE NEST OF THE SAL RED ANT (OECOPHYLLA SMARAGDINA).

DO THE LARVAE HELP IN MAKING THE NEST?

The nest is usually made with new leaves on soft succulent twigs. This selection is probably made for two reasons. Firstly because new leaves, being tender, are easy to manipulate and, secondly, because the young twigs readily yield a copious supply of sap which the ants require not only for their food but also for elaborating the glutinous silk web with which they join together the edges of the leaves to make the nest. A third reason is also possible, *viz.*, that the succulent twigs are usually covered with Aphids which are the "cows" of the ants and which furnish the ants with the much-prized sugary sap which they secrete. These Aphids are delicate little creatures, grey or dark-grey in colour, with a trilobed back and have a dark coloured tapering tail which can be prolonged by extrusion and lashed about freely.

For the purpose of nest-making the ants divide themselves into three primary working groups as follows:—

1. The soldiers, on watch duty. These are posted on the edges of the leaves which are being used for making the nest and on the surrounding leaves and twigs. These soldier ants are very alert and, on being approached with the tip of the finger or the cane, are most vehemently threatening, jerking vertically their abdomens, frequently and vigorously (but no fluid is squirted), and advancing to the attack with wide-spread mandibles. They are never afraid and are ever willing to take any risk and to face any danger. I once brought a lighted match sufficiently close to one of these ants to let it feel the heat without actually burning it. I expected that the excessive heat would force the ant to retire. But, to my surprise and before I could realize the fact, the ant had made a determined attack on the flame and had burnt itself badly, for which I was very sorry.

2. The sugary sap carriers. These seem to be intended to provide refreshment to the workers from time to time.

For this purpose they frequently visit the Aphids and suck off their backs the sap which they secrete; incidentally getting

their bodies also covered with the sap. On their return to the nest they are pounced upon by ;—

3. The workers, which may be sub-divided into :—

(*a*) The builders, which in their turn receive the sap from the carriers and which, literally, suck them dry. The scene of the transfer of the sap from the carriers to the workers is a sea of ants, mixed up in a hopeless, heaving tangle. I have, however, not been able to determine whether the intense commotion which goes on constantly inside the partly made nest is due solely to the sap sucking operation or whether it is, at least in part, due to some sort of activity in connection with reproduction. But I am absolutely certain that in no case was there a single larva inside the nest.

The workers after thus obtaining the sap go to the parts of the leaves which are to be joined together and secrete a silky web on the edges of both the upper and the lower leaf. When this process is sufficiently advanced the upper leaf is bent down by hundreds of the ants swarming right up to the edge of the leaf and thus weighting it down. When the edge of the leaf is sufficiently close to the corresponding edge of the lower leaf some of the ants, holding on to the leaf by means of their posterior legs, catch hold of the edge of the lower leaf with their mandibles, and drawing the two together hold them in place while the other workers are furiously at work joining the web together. When a leaf is found to be too tough for them, some of the ants cut the leaf-veins by biting at suitable places along the line of bending. This operation reduces the elasticity, and, at the same time increases the flexibility of the leaf. Thus the bending of the leaf is made easy. The marks of these cuts can be seen as dark scars on the leaf-veins.

(*b*) The sweepers. A number of ants are deputed specially for sanitation purposes and their only work seems to be to collect and throw away ant excreta and so to keep the nest clean. It was interesting to watch them doing this. The sweeper ants kept constantly moving all over the inner part of the nest and when one found the excreta, a tiny ball, it would pick it up and carry it along while searching for more. On finding another ball of the

excreta it put the two together and stuck them up with the sap; then it carried the two and added a few more (actually observed up to four). When it had secured a "full load" it took the composite ball, about 2 to 3 mm. in diameter, and dropped it over the edge of the leaf or left it outside the nest. Some of these balls got entangled in the web and remained there so enmeshed.

In connection with the nest-making by these ants Stebbing* states as follows :—

"The ant itself has no material with which to fasten the leaves, and so makes use of the larva which possesses glands secreting a sticky substance. Several ants pull the leaves together while others holding the larvæ in their jaws...........use them to moisten the edges of the leaves ".

Now, with due respect for the eminent entomologist, I feel constrained to differ from him regarding the above observation so far as it concerns the use by the ants of the larvæ in nest-making. I have watched, last winter, over a dozen nests in the making but I have not found the ants making use of the larvæ as described above. As a matter of fact the ants had no larvæ with them at all. And I took particular care to verify this. I therefore feel convinced that the larvæ play no part in making the nest and that the ants themselves elaborate the "sticky substance" with the aid of the sap which they suck from the leaf-veins and, possibly also, with the help of the sugary sap which they suck off the backs of the Aphids.

It is also interesting to note in this connection that a noted naturalist† in describing the nest of the Indian tailor bird (*Orthotomus s. sutorious*) makes the following remarks :—

"However, the structure that commonly passes for the nest of *Orthotomus* is a small-sized house of the red ant, which is made of leaves whose edges are brought together and held in place by means of glutinous silk *secreted by the ant itself*". (Italics are mine).

* A Manual of Elementary Forest Zoology, (1908), p. 72.

† Casey A. Wood, in the Annual Report of the Smithsonian Institution, 1925, p. 350.

Is it, then, that the balls of excreta carried by the sweeper ants have been mistaken by Stebbing for the larvæ? I myself did that at first. But when I placed one of the balls on the palm of my hand and examined it with a lens I found that it did not look at all like a larva. And, further, when I crushed it between my thumb and fore-finger it resolved into wood-dust.

I shall feel obliged if some of your esteemed readers will throw further light on the question of the use, or otherwise, by the red ants, of the larvæ in making their nest, by publishing the results of their own observations in the *Indian Forester*.

DEHRA DUN:
1st *September*, 1929.

J. N. ONIAL,
Forest Ranger, U. P.

RÉSUMÉ OF THE PRESENT POSITION OF THE TIMBER MARKET ARISING OUT OF THE TENDERS FOR CHIR, FIR AND SPRUCE SLEEPERS RECENTLY INVITED BY THE NORTH WESTERN RAILWAY.

The following notes were made with the object of placing before the Chief Engineer, North Western Railway, a statement of facts regarding the present timber position, and figures which help to prove that the production of a fir B. G. @ Rs. 2-12-0 (the Railway's fixed price) can only be accomplished at a loss to the contractor.

There are four main points to consider in ascertaining the value of a fir B. G.—

(1) Working Costs.
(2) Royalty.
(3) Capital Expenditure, (*a*) Profit.
(*b*) Interest.
(4) Revenue. (Sales).

(1) *Working Costs.*—The costs of manufacturing a broad gauge wooden sleeper and extracting it from stump to rail-head, depends largely on the topographical nature of the forests from which it is worked, but the cost, from many years' practical experience, has been proved to average about Rs. 2-8-0 per B. G.

In the case of fir the extraction is rather more expensive than that of deodar or kail, since the fir trees grow in higher altitudes and therefore tends for longer leads from stump to floating stream, or alternatively for longer and very much more difficult *nullas* to float out of.

Though we contend that the extraction of a fir B. G. is more expensive than that of the cost of an average wooden sleeper we will take, for purposes of calculation and to save argument, the lowest estimate given—that of the Forest Officer—in Appendix II, page 36 of the Report of the Sleeper Enquiry Committee 1923-24, with the addition of the Re. 0-3-0 on account of interest on capital locked up. The figure shown in the estimate referred to, *i.e.*, Re. 0-1-0 is obviously wrong.

As we are considering the cost of a fir B. G. and not that of a deodar B. G., as set forth in the Report of the Sleeper Enquiry Committee, let us leave out the matter of royalty for the moment, and consider actual working costs.

	Rs.	a.	p.
Felling	0	1	0
Sawing	0	8	0
Carriage to *nala*	0	8	0
Floating	0	5	0
Rafting	0	4	0
Establishment	0	4	3
British Fees	0	0	3
Grain Compensation	0	2	0
Total ...	2	0	6

Not having included the cost of royalty, it is necessary to omit for the present (1) interest on capital locked up, (2) river loss, and (3) profit.

(2) *Royalty.*—The royalty paid on fir is a very small proportion to the rest of the cost of production. It varies in different

leases from Re. 0-3-0 to Re. 0-9-0 per B. G. Fir at Re. 0-3-0 is only obtainable in forest leases where the main species is deodar or kail, the bid for fir having little or no effect on the sale price of the forest lease. Where the main produce is fir, royalty at the moment averages about Re. 0-7-0 to Re. 0-8-0 per B. G.

Let us take Re. 0-4-0 per B. G. the lowest possible figure at which the State would be likely to sell their fir trees, presuming they were auctioned in pure fir forests or where deodar or kail does not prevail. At Re. 0-4-0 the trees would not be worth more than about Rs. 3 or Rs. 4 each.

(3) *Capital Expenditure.*—We have, therefore, so far arrived at two figures regarding which there can be very little argument or reduction :—

Working Cost Rs. 2-0-6 and Royalty Re. 0-4-0. A total of Rs. 2-4-6 per B. G.

This figure multiplied by the total forest outturn has to be paid very nearly in full before any revenue is received. Let us therefore, consider the capital required to work a forest, the outturn of which from conversion will amount to 1,00,000 sleepers.

Working Costs on 1,00,000 B. G. @ Rs. 2-0-6	...	2,03,125
Royalty „ „ „ „ Re. 0-4-0	...	25,000
Total	...	2,28,125

To this figure we have to add interest on capital locked up and the profit. Very few firms would consider investing capital under 20 per cent. in a business like this, where there is the ever present fear of floods, which may mean very nearly the entire loss of capital in one year. On several occasions floods have caused losses of over 20 per cent. on the outturn, which means, of course, not only loss of profit, but possibly the loss of capital also.

Interest including profit at 20 per cent. on a business undertaking may appear to some to be too large a profit to expect. We will assume then that 15 per cent. only is made, and let it be

noted that this 15 per cent. includes not only interest on capital locked up for more than a year, *but the profit also.*

The result would be as follows :—

		Rs.	a.	p.
Working cost and royalty	...	2,28,125	0	0
Profit and interest on capital	...	34,218	0	0
Total	...	2,62,343	0	0

Revenue.—We have now to sell our outturn of one lakh sleepers or as much of it as will arrive at the depôt, at such prices as will bring in a total of Rs. 2,62,343.

River Loss.—Under favourable conditions loss in river transit may not exceed 10 per cent. though in the case of fir which easily becomes water-logged, the losses generally exceed those of other species.

Ten per cent. river loss for an outturn of 1,00,000 gives a depôt arrival figure of 90,000. The whole of these 90,000 sleepers will naturally not arrive in first class condition. From 5% to 10% will be broken and fairly useless, while anything from 10% to 30% are rejected or classified as 2nd and 3rd class by the Railway. Taking the lowest of the above figures, the following results are obtained :—

				Rs.
76,500	1st class railway sleepers @	Rs. 2-12-0	each	2,10,375
9,000	2nd and 3rd class sleepers @	Re. 1-6-0	„	12,375
4,500	Rejections-broken-useless @	„ 0-8-0	„	2,250
90,000				2,25,000

Profit and Loss Account.

		Rs.	a.	p.
Total Expenditure...	...	2,62,343	0	0
Total Revenue ...	...	2,25,000	0	0
Net Loss	...	37,343	0	0

A reference to the Sales Account shown above will show that an increase of Re. 0-8-0 per sleeper on the price of a fir B. G. will bring in a further Rs. 38,000 *i.e.*, sufficient to cover the loss shown in the Profit and Loss statement of account above. It would appear, therefore, that Rs. 3-4-0 is the lowest possible price at which it is feasible to work out a fir B. G., and even at this price the contractors are only making a profit of Re. 0-7-0 against the universal expectation of sleeper contractors throughout India of Re. 1 per sleeper.

	Rs.	a.	p.
Working Costs as shown on page 671 ...	2	0	6
Royalty	0	4	0
River Loss	0	4	0
Interest on Capital (9% p. a. for 18 months)	0	4	6
Profit	0	3	0
Average Sale Price	3	0	0

It will be seen, therefore, that @ Rs. 2-12-0 per sleeper there is but the negligible profit of Re. 0-1-0 per sleeper, and this after taking the absolute minimum cost of extraction. Only in the most accessible forests, under the most favourable conditions and with the minimum of rejections could a fir B. G. be produced at even a one anna profit. In the estimate given no allowance has been made for bad debts, forest damages, insurance or depreciation. No one would consider working new fir forests at this price. The only fir offered at Rs. 2-12-0 in the last tenders was unsold stock likely to depreciate, timber which contractors are compelled to extract under their forest agreements. Fir sold at this price can only be given where it is produced in deodar and kail forests, and at a loss to the profit on the latter, which even now is at a minimum.

Conclusion.—The cost of producing any wooden sleeper from the Kashmir State or Punjab Forests, apart from royalty and

profit, amounts to Rs. 2-9-0. This gives the following sale values :—

	Working Costs.	Royalty.	Sale Price.		
			Profit @ Re. 1.	Profit @ Re. 0-12-0.	Profit @ Re. 0-8-0.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Deodar ...	2 9 0	3 0 0	6 9 0	6 5 0	6 1 0
Chir ...	2 9 0	1 0 0	4 9 0	4 5 0	4 1 0
Kail ...	2 9 0	0 12 0	4 5 0	4 1 0	3 13 0
Fir ...	2 9 0	0 4 0	3 13 0	3 9 0	3 5 0

The only way to reduce the sale price of the above sleepers is to reduce the royalty. The contractors' profits have already been cut from Re. 1 to Re. 0-12-0. By reducing their profit still further to Re. 0-8-0 the sale price of deodar will still be over Rs. 6 per sleeper, and a fir B.G. Rs. 3-5-0.

It is obvious then that the cut must come from the owner of the forests.

Realising the attitude of the Railway regarding the cutting of sleepers prices, contractors had to reduce their royalty offers in the last tenders for the main Kashmir forest leases in 1927. These tenders were high enough to bring in the same royalty as the State had been receiving before the last five year leases, and at the same time would have enabled contractors to sell sleepers at a lower price to the Railway. However, the Kashmir Government were determined to obtain the same revenue as they had been receiving during the past seven years when they were sharing the profits made by the contractors, and so called for fresh tenders. New tenders being called, contractors had to raise their offers very considerably since their previous figures had been made public property. Unless prices are maintained or forest owners agree to accept less for their trees, and so help to bear the reduction in prices as they shared in the profits in the past, many contractors will go into liquidation, and the timber market will become as unstable as any market in which no co-operation exists.

There appear to be three possible solutions to the problem :—

1. The reduction of royalty on the part of the forest owners.

2. The introduction of a scheme to limit production in proportion to the demands of the Railway. This can only be achieved by knowing the railway's requirements for five to six years ahead.

3. Co-operation between the forest owners, the railway *and* the contractors.

The latter are, as a general policy, not consulted at all, whereas their co-operation might very considerably be the means of keeping prices down. They naturally want as big a return as possible on their investment, but they are considerably keener on making a certain and steady return on their money.

F. W. V. ELLVERS,
General Forest Manager,
Spedding, Dinga Singh & Co.

REVIEWS.

THE PRACTICE OF SILVICULTURE.

BY R. C. HAWLEY.

Second Edition, New York, 1929. pp. 335, price 20*s*.

This work, as its sub-title emphasises, is written with particular reference to N. America and at its first appearance 8 years ago was almost the only alternative to Schlich's Manuals. Since then, we have had several books dealing with Silviculture in whole or part, among which Troup's 'Silvicultural Systems' (1928), and Toumey's 'Foundations of Silviculture on an ecological basis' (1928) are the most important. The last forms a useful complement to the publication under review, as their titles suggest. This second edition does not greatly differ from the first, but fire protection takes up even more space than before—over 80 pages out of the 300, and is perhaps the most interesting part of the book, at least to the non-American reader who is glad to have an up-to-date review of western procedure in this very important matter. Earlier chapters deal each with a method of reproduction, one of which, *viz.*, the "Seed Tree Method", we do not usually differentiate, though we have practised it with *Pinus longifolia* and perhaps other species in the past.

Each chapter closes with references to selected literature and the forest terminology adopted by the Society of American Foresters is appended wherefrom the foreigner may learn what *volunteer growth*, *water sprouts*, and *oppressed trees* are, and the meaning of *interlucation*. There is a useful index which could have been further improved by emphasising the main references,

and some 70 diagrams illustrate the text concerning fellings of all kinds. Great Britain has still to produce a short but comprehensive work of this kind and so has India.

H. G. C.

"FORESTRY."

The first part of Vol. III of Forestry has recently been published, and is priced *7s. 6d.*

The Society of Foresters of Great Britain was founded in 1925 with the object of advancing and spreading in Great Britain the knowledge of technical forestry in all its aspects. The previous two volumes of the Society's journal were published in 1927 and 1928 and a change has been made this year in publishing the third volume in two parts, the second of which is to appear shortly.

The number under review contains eight articles, besides reviews and notices of recently published books on forestry. The journal opens with an account by R. L. Robinson of the Third Empire Forestry Conference, which was held in Australia last year. The article, for obvious reasons, does not attempt to go into great detail, but summarises the discussions and the resolutions passed. It is a very useful statement of the general outlines of what work was done by the Conference.

The second paper on the relationship between silviculture and the utilisation of timber is an account of the Society's excursion to Lake Vyrnwy and Liverpool and of the discussions with the Liverpool Timber Trade Association, on the subject of co-operation between the producers and the users of timber.

W. E. Hiley's paper on the cost of production of timber in Britain presents a somewhat novel way of expressing the possible financial results of forestry in the form of tables, which give the cost per cubic foot of producing trees at 4 per cent. etc. interest under certain stated assumptions as to costs of management purchase price of soil, etc. The object of the paper is to get over the difficulty, which some people have in interpreting the usual statement of the financial possibilities in the form of a calculated

soil expectation value or a rate of interest, which may be earned if land can be bought at a given price. It is stated that the prestige of forestry economics has suffered from the fact that the usual methods of presentation are unconvincing to practical foresters. Hiley's paper may therefore be of value in presenting the case somewhat differently and thereby convince a few more unbelievers that in British forestry, if good management is assured, a return of 4% may be expected. The same conclusion could, however, have been arrived at by the ordinary methods, from the data which Hiley uses.

Prof. G. W. Robinson contributes an interesting article on "Waste lands of North Wales", with reference to their suitability for sheep-farming or afforestation. He arrives at the general conclusion that their value for pasturage and their value for afforestation generally run parallel, so that there are consequently no very large blocks of land in North Wales, which can be readily spared from grazing and which are at the same time highly desirable for afforestation purposes. "Oak mildew and its control in forest nurseries" is an interesting history of the fungus since its first appearance in Britain and on the Continent, with an outline of its life history and descriptions of experiments in controlling it in forest nurseries. This might have been published with advantage as a separate memoir and the same remark applies to "The biology and control of *Hylobius abietis*" by J. W. Munro, the first part of which appeared separately in the second volume of the journal a year or more ago.

M. C. Rayner summarises the research that has been done up to date on "The multiple mycorrhizas of trees" and foresees a time when the control of mycorrhiza formation will be recognised as a necessary and important operation in practical silviculture.

A short article by W. E. Wilson, Officer in charge of Machining Tests, Forest Products Research Laboratory, Princes Risborough, on Woodworking machinery with special reference to the building trade is a brief description of the commoner types of machines used in a building trade workshop, including notes of the speeds usually used.

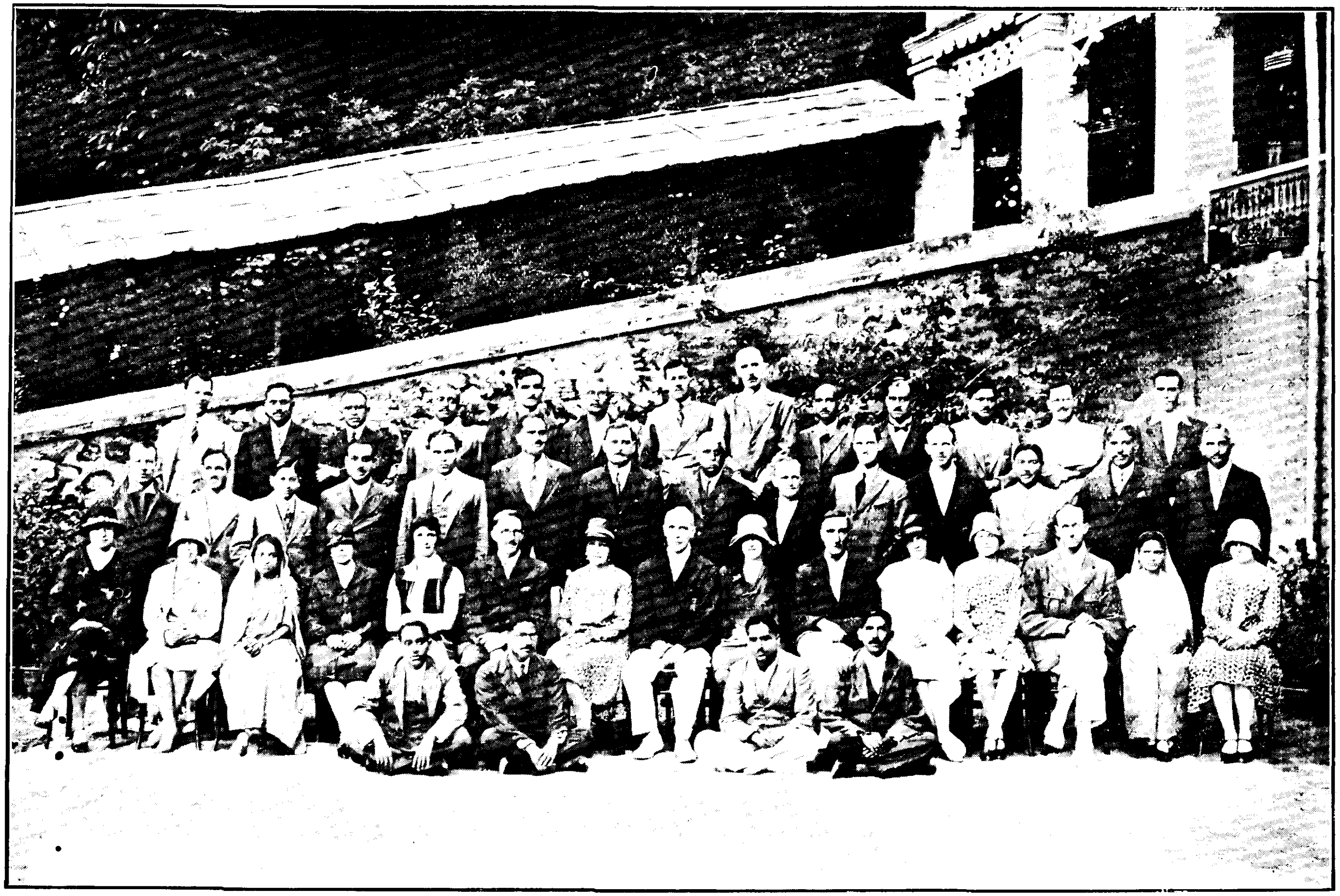
THE STRUCTURE AND LIFE OF FOREST TREES.

By Dr. M. Büsgen, Professor in the Royal Prussian Forest Academy in Hann-Münden.

Third Edition, by Dr. E. Münch, Professor in the Forest Academy at Tharandt.

Translated by Thomas Thomson, M.Sc., University Lecturer in Forestry, University College of North Wales Bangor.

The first edition of this comprehensive work appeared (in German) in 1897 and Mr. Thomson has now provided us with the first English translation. Dr. Büsgen died in 1921 and the present edition owes much to Dr. Münch. The scheme of the work is extremely comprehensive and ranges from full descriptions of the growth of the various parts of the tree, to its "water economy" and local races. The style of the translation does not always make the book easy to read, for example, "The condition in which the cessation of growth in the summer is not associated with the formation of a closing bud but only with a period of rest, sometimes accompanied by the formation of structures intermediate between bud-scales and normal leaves, Späth terms "Concealed Lammas-shoot formation", and it must be confessed that there are a good many of these rather trying statements in this fine volume of over 400 pages. Having had our little grumble, we may proceed to admire the wealth of knowledge and reference that has been collected. Hardly a page is without its bibliography, mostly German, and the forest officer who is determined to know every secret of the inmost life of his trees has here all the material at hand. A common phenomenon in England, the dead dry leaves on beech or hornbeam hedges in winter, is explained by Lakon as being due to the better supply of nutrient salts and water to the twigs that do not shed their leaves. The reviewer seems to remember that he was taught that it was due to the leaf base being surprised and killed by frost before the separation tissue is formed. This is stated in this volume as a *possible* cause. We have another criticism to make of this really wonderful book, and that is the absence of a glossary. Special and often recondite



GROUP OF SOME U. P. FOREST OFFICERS.

From Left to Right.

Top row standing.—Messrs. Monro, Jangbahadur, Hakimuddin, Bansal, Sewal, Girdharilal, W. F. Coombs, Johnstone, Rizvi, Webb, Pant, MacDonald, Mobbs.

2nd row standing.—Messrs. Duncan, Sah, Sen, Brahmwar, Chaturvedi, K. D. Joshi, G. O. Coombs, Tula Ram, Owden, Hall, Davis, Hira Singh, Haq, Bhatia.

3rd row sitting (chairs.)—Mrs. Johnstone, Mrs. Davis, Mrs. Sen, Mrs. Coombs, Mrs. Smythies, Mr. Cooper, Mrs Channer, Mr. Channer, Mrs. Cooper, Mr. Smythies, Mrs. Hall, Mrs. Mobbs, Mr. Herbert, Mrs Negi, Miss Johnstone.

4th row sitting on ground.—Messrs. Kakazai, D. D. Joshi, Negi, Radhakishen.

terms are employed freely, and it is possible that the majority of readers of the volume will be ignorant at times of their meaning. The illustrations are numerous and of fair quality.

Some of the photographs are rather poor and we notice that a number of the well known old drawings, for example those of the catkins of birch and alder, have again been pressed into service.

We hope that in the next edition some of the faults in this fine volume will be corrected.

It is published by Messrs. Chapman & Hall, Limited, London, and its price is 30 shillings.

EXTRACTS.

COPAL AND DAMARS.

At a recent meeting of the Royal Society of Arts an interesting paper on East Indian copals and damars was presented by Mr. A. F. Suter, which has appeared in *Jour. Roy. Soc. Arts*, Vol. 77, April 19. The distribution of resiniferous plants is world-wide. Of the resins known to commerce the two chief groups are the copals and the damars. This division of the major resins is somewhat arbitrary, being based upon the difference of their physical characteristics, but is, however, quite a useful one.

There are eight commercial copals, their names indicating the country of origin, namely: Macassar or Manilla, Kauri, Congo, Zanzibar or Lindi, Mozambique or Inhambane, Sierra Leone, Angola (Benguela), and Demerara. The first two are obtained from species of *Coniferae (Agathis)*, whilst all the others come from leguminous species of trees. The damar-producing trees all belong, so far as present known, to the order *Dipterocarpaceae*. They are largely collected in the Federated Malay States, Sumatra and Borneo.

Considerable confusion has existed in the past on the subject of copals and damars. Mr. Suter states that the name copal, which is the Mexican for resin, is unknown in the East, where both copals and damars are known as damar, the Malay name for resin or a torch made of resin. In Europe, in the trade, both groups have been erroneously called gums, on account of their physical similarity to true gums. The author's paper mainly concerns copals, and deals chiefly with Macassar or Manilla copal which is obtained from *Agathis alba*, where it occurs most commonly in the Dutch East Indies; the tree is also found in the Celebes, the Moluccas, Borneo, Sumatra, and New Guinea. It is also present in the Philippines, where it is exploited, and in the Federated Malay States, where the resin is not as yet collected. The *Agathis* has characteristics in common with the *Araucaria*, and Mr. Suter deals at length with the tree and its habitat, the nature of the resin and the methods of tapping the trees.

The various types of Macassar copal known in the trade are: (a) hard or fossil copal, of unknown but often very great age, and very hard, (b) half-hard copal, less hard and much younger, (c) soft or spirit-soluble copal. The first is found either in the crotches of branches in old trees or else dug from the ground under old trees at or where trees one time existed; the other two are of

recent origin and are obtained by tapping the trees. Mr. Suter directed attention to the very efficient Dutch Forestry Department, which has studied the copal business and industry with great thoroughness.

(*Nature, 7th September 1929.*)

AFFORESTATION IN PALESTINE.

LORD ALLENBY'S APPEAL

Field-Marshal Lord Allenby spoke on afforestation in Palestine at the annual general meeting of The Men of the Trees Association at the Imperial Institute, South Kensington, last evening. Sir Francis Younghusband presided.

Man, said Lord Allenby, had a bad record as a destroyer of trees throughout the ages, until the world was threatened with timber famine. The Near East had suffered cruelly and Palestine in particular. Lebanon, Carmel and Gilead were bare, the coastal plain was denuded, and the Pride of Jordan was disappearing. Happily, the Men of the Trees had taken action; and they were bestirring themselves to restore to these ancient lands their pristine beauty. Perhaps, within a generation, for trees well tended grew apace in Palestine, the naked hills would once more be clothed. Vegetation would bind the soil with its roots and save it from being carried off by the winter rains. Moisture would be retained, keeping the water springs full and overflowing, to make even more fertile the already fertile valleys. It was to be hoped that foresters would take care to preserve and to plant anew the native trees of the country. Quick growers of foreign origin—such as gums and wattles—were in favour with farmers and settlers, but those aliens had not the natural dignity of the aboriginal trees—oak, ilex and terebinth, caroli, box, pine, cypress, plane, walnut, sycamore, acacia, and olive. Slow growers, some of these, but worth waiting for. Utility should be no enemy of beauty.

MRS. GRANT DUFF, the Hon. Secretary, said that a surprisingly large number of young plantations were destroyed by fire annually in this country. The voluntary efforts of the association, among school children, Boy Scouts, and Girl Guides, had been helpful in the direction of mitigating this loss and in developing a tree sense in every citizen.

LORD CLINTON, Chairman of the Forestry Commission, said that almost all States within the Empire and nearly every country in the world was now adopting some form of forest policy. At the moment those forms were very inadequate indeed, but the fact that the devastation had been brought to the recognition of the public generally made one hope for a great deal in the future. In Great Britain we had no right to throw stones at anybody for wasting forests, for we had destroyed our forests centuries ago. Speaking of the great loss occasioned in different parts of this country as a result of timber fires, Lord Clinton said that the Forestry Commission alone had lost

5,000 acres this year, a very serious matter having regard to the small area that had been planted. Of recent years there had been considerable activity by the British Government in afforestation, but he was bound to admit that we were not planting any really great area with the really indigenous trees of the country. It had to be remembered that, in the hands of the State, forestry was a commercial undertaking. As to the trees used in construction, 95 per cent. were of the soft wood type, and quick growing coniferous trees had to take the place of those which were so typical in the past of our southern country. But there need not be too great antagonism between the two sides of forestry nowadays—silviculture which grew wood for use and arboriculture which grew trees for ornament and amenity. The last-mentioned side was endangered by the breaking up of large estates. When this occurred the ornamental grounds, and park timber went with the estates. Unless some real effort could be made to educate the public as to the value of such trees they might be lost altogether.

Mr. Richard St. Barbe Baker, who has recently returned from Palestine afterwards showed a forestry film taken by him in that country, and made a strong appeal on behalf of the Men of the Trees Palestine Fund which has been established to provide labour for the planting and after care of trees in that land.—(*The Times*).

WILD LIFE OF GUIANA RAIN-FOREST.

AN OXFORD EXPEDITION.

A party of scientists from Oxford University, with some colleagues from Cambridge, is starting to-morrow from London in the Ingoma for British Guiana. The expedition, which is led by Major R. W. G. Hingston, is composed of zoologists and ornithologists, an entomologist, a botanist, and a surveyor, and will principally investigate the wild life of the Guiana rain-forest.

Darwin, Hudson, and Bates, whose influence has proved revolutionary far beyond the bounds of biology, made South America classic ground for English naturalists by drawing their material from it. But during the present century that field has been allowed to fall almost entirely into American hands, and even in the only British Colony on the mainland south of the Caribbean much of the most notable recent work has fallen to scientists from outside. The decision of the Oxford University Exploration Club to send out an expedition to British Guiana has, therefore, not merely a scientific interest.

Oxford since the War has run four successful expeditions to the North, one to Greenland and three to Spitsbergen, but none of these touched British territory. The establishment of a strong Exploration Club with the active support of the University authorities has already given some guarantee of the development of the expedition system at Oxford The choice of British Guiana shows that Oxford is no longer to be restricted as once seemed likely

to Arctic excursions within the limits of the long vacation. If the present experiment prove a success, it may become the first step in a fruitful partnership between picked expeditions of Oxford and other scientists on the one hand and the too few permanent trained men scattered over the Empire on the other. These expeditions, brief as they are, have already proved their value. They bring out investigators of a type who would never otherwise have been seen in their field of operations. By the co-ordination of results in the field and the training of an undergraduate element in contact with new problems and trained men they form a weapon of research far exceeding the sum of the individuals concerned. They represent the new exploration rather than the old age of discovery, but even in discovery they have possibilities, as the first crossing of North-East Land and the attachment of a Royal Geographical Society surveyor to the present expedition have shown.

Tree-top Life.

After last year's Greenland Expedition it was desirable to postpone further work in the North until the results should have been fully examined by the specialists; the opportunity to break away from an Arctic tradition seemed favourable. The Exploration Club accordingly invited Major R. W. G. Hingston, who had served as second-in-command of its Greenland Expedition and had a long tropical experience, to lead and to undertake the organization with the aid of some undergraduate members at the Oxford end. Through the friendly interest of the Vice-Chancellor the University gave the scheme its fullest support, and went so far as to vote a grant just after hearing of the deficit in its last year's finances. A very substantial contribution from the Percy Sladen Fund put the expedition on its feet; the Royal Society made a further grant, and help was also forthcoming through the West India Committee and the good offices of the Exploration Club's president, Col. John Buchan, M. P. The Royal Geographical Society and the Royal Botanic Gardens, Kew, undertook the entire expense of attaching a surveyor and a botanist. The Colonial Office and Governor of British Guiana have been generous in their assistance, and the expedition sails with nothing left undone that anyone could do to ensure its success. Much free transport in Guiana has been promised by the Colonial Government, and the cost of the Atlantic passage has been considerably reduced by the generosity of the Harrison Line.

Arriving at Georgetown early in August, the expedition will proceed, with the advice and aid of the Government of the Colony, to a locality north of the Essequibo, where it will form a base camp from which the surveying party will operate, while the scientists begin intensive work on the spot. A main object of the expedition is to get into the canopy of the rain-forest in order to study at close quarters the many more or less unknown animals which live there, 200 ft. above the ground. To this end it is bringing out a variety of appliances, including Schermuly rocket apparatus, B. S. A. line-throwing guns, "dogs and spikes" to hammer into the trunks, and so on; if one method fails another ought to succeed. The

generosity of the firms which have presented or lent much valuable equipment, ropes, and other apparatus such as the wireless for communication with Georgetown, enables the expedition face this task of illuminating the obscure life of the tree-top zone with a minimum of handicaps.

Several of the members must return in October to keep their Michaelmas term, or for other reasons, but about half will remain till December, and will not be home until January, 1930.

The expedition is composed as follows :—

MAJOR R. W. G. HINGSTON, M. C. (late I. M. S.; naturalist and M. O. to Third Everest Expedition, Second-in-Command, Entomologist and M. O. to Oxford University Greenland Expedition, 1928), leader, M. O., and entomologist.

FRANK BUCKLAND (Oriel, Oxford), zoologist and assistant M. O.

M. J. CRESSWELL (New College, Oxford), operator for wireless and tree-climbing apparatus.

J. E. DUFFIELD (Dept. of Zoology, Oxford), zoologist.

S. T. A. LIVINGSTONE-LEARMONTH (Trinity, Cambridge), taxidermist and assistant surveyor.

B. D. NICHOLSON (Balliol, Oxford; ornithologist to O. U. Greenland Expedition, 1928), ornithologist.

E. M. NICHOLSON (Hertford, Oxford; ornithologist to O. U. Greenland Expedition, 1928), ornithologist.

O. W. RICHARDS (Brasenose, Oxford, and Imperial College of Science), entomologist.

P. W. RICHARDS (Trinity, Cambridge), botanist.

N. Y. SANDWITH (Keble, Oxford, and Royal Botanic Gardens, Kew), botanist.

L. SLATER (St. Catharine's, Cambridge), surveyor.—(*The Times.*)

USES OF EMPIRE TIMBERS.

RESEARCH BOARD AND INDUSTRY.

In presenting their report to the Department of Scientific and Industrial Research for the period ended September 30, 1928, the Forest Products Research Board take the opportunity to restate their policy and to set out the programme of work which they are attacking (H. M. Stationery Office, price 3s. net). The document is a long one, and includes the report of the board's director, which describes in technical detail, with illustrations, numerous investigations now being carried out.

The report shows how the laboratory of the Department is assisting industry and helping to develop the timber resources of the Empire. It points out that the wholesale felling of British woodlands during the War, the rise

in prices, and the threat of a world scarcity of "softwood" building timber combined to attract attention to the question of timber supplies as an urgent one. Realization that existing supplies could be conserved, not only by proper management of the standing crop, but also by the reduction of waste in the use of timber, led to the establishment of the board and laboratory.

The laboratory has had to cope with a great many difficult problems in dealing with inquiries by commercial concerns. It was approached, for instance, by the Federated Home-Grown Timber Merchants' Association on behalf of one its members—a large concern in Lincoln—to find uses for planing mill wastes, shavings, and so on. Investigations are being made to discover whether the waste might be used—after grinding—in place of the wood flour now imported from Germany and Scandinavia. Specimens prepared by the laboratory in its wood chemistry department have been submitted to linoleum manufacturers for trial purposes, and the reports are hopeful. A London firm asked for assistance in finding suitable timbers for the manufacture of boot lasts. Various Empire and home-grown timbers were suggested, of which possibly either home-grown or Canadian birch may be found suitable. A Glasgow firm, obliged to import chestnut fence pales from France, was placed in touch with the Forestry Commission regarding the development of chestnut areas in Gloucestershire, where steamer shipment appeared to be a possibility.

Decks and Floors.

Information has also been supplied to a large timber-importing firm on the relative value of certain Empire timbers with a view to substitution for American pitch pine as steamer decking. Frequent requests are received for authenticated commercial specimens of timbers, particularly of Empire origin, and also for specimens for general information. For instance, steps have been initiated, in co-operation with the Office of Works, for examining the value of home-grown beech as a flooring timber. Again, if some form of collective supply can be made available home-grown beech may be able to compete successfully with imported Continental beech now used in very large quantities for furniture manufacture.

A mining concern experiencing trouble with pitch pine cage-guides asked for a specification to ensure the supply of the correct class of timber. While full information was given as a matter of general assistance, attention was drawn to the Empire woods from Canada and Australia suitable for the purpose. The names of suppliers and prices were also given; incidentally, these prices were less than for the American timber previously used. A preliminary inquiry has been made, in collaboration with the Office of Works, into the steps which can be taken to substitute an Empire-made product for the American and Scandinavian doors now reaching the British market in such large quantities.

The laboratory was approached by a firm concerning timber for drum shells, usually made from wide ash (now becoming scarce) or, more recently from American magnolia. Tasmanian myrtle was suggested to them, and an

order has been placed for some logs of this timber for the purpose of trial. Grading specifications were prepared concerning timber for use in the manufacture of ladders for a London company. This dealt with a number of Canadian timbers to take the place of Scandinavian ones for certain types of ladders. After a period it has been found that the Canadian timbers so described are now extensively used by the company in the manufacture of their products.

An indication of the assistance which may be given by the laboratory to the Dominions is afforded by the request from the Agent-General, British Columbia, for technical information relative to Canadian Douglas fir, with a view to its possible use instead of American pitch pine in the Port of London Dock extension work. Following a careful examination of the subject from the engineering standpoint, including inspection of works in Belfast Harbour, a report was prepared and forwarded, embodying also a note on the strength factors and similar qualities. The Agent-General was successful in having at least half a million cubic feet of the Canadian timber specified and used.—(*The Times.*)